THE ENGINEERING MAGAZINE

THE WORLD IS ITS FIELD

VOL. XL. FEBRUARY, 1911. No. 5.

# ENGINEERING IN THE NAVY. ITS ORGANIZATION AND EFFICIENCY.

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Present conditions in the United States Navy are of acute interest. The situation focalizes movements that are stirring in all the great navies of the world—the cumulative effect of the influence of engineering upon personnel, material, and organization, as steam and power have progressively displaced sail and hand service.

Professor Hollis weighs the questions at issue with the sympathetic and intimate knowledge acquired by long naval service, but with the breadth of vision and perspective acquired by long removal from that service and constant contact with the methods and ideals of general engineering practice. His conclusions, reached without impetus of any special interest, without bias of any departmental relation, without even mental suasion of any particular industrial philosophy, should be of much weight, as they add authority to their sincere purpose to arrive at truth. They are presented in the same spirit in which they were prepared.—THE EDITORS.

A MODERN battleship is the most complicated structure designed and built by engineers. It is essentially a power-station of large dimensions which is capable of moving, and within which the operating force must live. Furthermore, they must be able to make their own repairs so far as possible within the limits of the hull, and they carry as part of the machinery, offensive power capable of reaching out seven miles. To one not trained in engineering a battleship is a profound mystery. Its power is incomparably greater than that in any industrial establishment even on shore a generation ago. A single one of the American battle-fleet lately returned from Europe, in the hands of the Confederacy, would have destroyed the entire Northern navy. Not a ship, nor any combination of the then existing ships, could have remained on the blockade. The cost of a modern ship must therefore be contrasted with that of an entire navy in the past of only forty years ago, in order to get anything like a fair idea of what should be paid for new ships.

The change from the old types has been entirely one of engineering, necessitating a complete reorganization of the personnel to fit modern requirements. The new United States navy was begun by Secretary Whitney in the purchase abroad of the plans for three cruisers and one battleship. Previous to his administration, all cruising ships had been constructed with sail power. The navy had been so long under an old system that we had no architects or engineers conversant with modern construction for high-speed ships. Mr. Whitney's action was, therefore, both patriotic and courageous, and by it we were put in the way of replacing our decaying ships and of ridding ourselves of the old fetich of "keeping the sea under sails."

It was during his time that a large contract for armor-plate was signed with the Bethlehem Company, thus justifying a large initial expenditure in the establishment of an armor-plate manufactory. The gun foundry at Washington was also authorized by Congress at the same time. The progress since Mr. Whitney's administration has been rapid, as ship after ship has been replaced and the navy has regained the effectiveness it had at the close of the Civil War, except that this recovery is under totally different conditions.

With the building of an engineers' navy the education and training of men for service afloat had to be modified, but the change came hard as all the senior officers in control during the years preceding the Spanish War had learned their professions under an antiquated system. The Personnel Bill was passed by Congress early in 1899. It had many good features, the principal ones however being an amalgamation of the line and engineer corps into one corps, the establishment of a grade of warrant machinists, and the correction of inequalities as to pay. Many were the dire results predicted as the consequence of the disappearance of the technical corps whose duties had been exclusively with machinery. The measure was framed in reality for two reasons: one was to cause every line officer to pass through an engineering apprenticeship; and the other was to break up the eternal fight between the line and staff. This fight had reappeared in every session of Congress from the close of the Civil War. It has sometimes been treated as the inevitable struggle between corps in every military system, but it was far more than that. The last forty years have been a period of readjustment, not only in the navy but in all modern industries, and precisely the same struggle has taken place in civilian establishments that we have observed in the navy.

The line in swallowing up the engineer corps brought itself into correspondence with modern conditions by converting itself into a larger engineer corps. The Personnel Bill thus ended, we may hope

forever so far as the organization afloat is concerned, that useless struggle which set against one another men of high motives and conscientious desire to serve their country faithfully. In taking the engineer corps into the line, the navy reserved all the older officers who had been chief engineers, exclusively for engineering duties, and they have served to train the young line officers to succeed them. The younger members of the engineer corps were taken bodily into the line in every sense of the word. The troublesome period of readjustment has thus been tided over by a liberal infusion of trained engineers into the executive branch. The fate of the older engineers has been an unhappy one, and they have scarcely received the recognition they deserve for faithful and unselfish service. The task of training the younger officers to take their places, while being pushed into the background themselves, was a very severe test of patriotism and unselfishness.

The course at the Naval Academy quickly responded to the changed requirements for its officers and it became in every respect an engineering school equal to anything in the country. In one important respect it is better than most other schools; men are there taught to do without question what they are told to do, so that some deficiencies in the curriculum are more than made up in the stern discipline which prevails over all. The training of the enlisted men was quickly made to fit the new demands, and best of all, in the Personnel Bill, a way was found to reward good practical mechanics by promotion from the ranks to a grade of warrant machinist. The law also allows, in exceptional cases, the warrant officers to obtain by examination and record the same commissions as those held by graduates of the Naval Academy. The navy is thus a thoroughly democratic institution and any fireman has the way open to a commission in the line of the navy if he has the ability, energy, and youth necessary to obtain it.

Thus by legislation and executive action in connection with materials during Mr. Cleveland's first administration and again by legislative action affecting the personnel during Mr. McKinley's administration, a complete revolution was accomplished in the navy. Strange as it may seem, that revolution did not extend to methods of doing work in the navy yards, although a legitimate consequence of the personnel legislation. The old methods prevailed until they were modified by a sweeping executive order issued at the very close of Mr. Roosevelt's administration. This order took up the subject of concentration of work in the navy yards and followed it to its logical conclusion by abolishing completely the bureau departments of the yards and placing all work under the direction of a manager subject to orders by the commandant. The plan was in the right direction,

but it went too far and aroused intense antagonism throughout the entire Service.

A great opportunity thus awaited Secretary Meyer to complete the work begun by his predecessors, and especially that inaugurated by his immediate predecessor. Fundamentally, it is simply extending the legislation as to personnel and materials afloat into workshops that serve for construction and repairs. Some new legislation is required, but it is simply a corollary to the action already taken by Congress in the passage of the Personnel Bill.

The new Secretary has, unfortunately, found the same kind of opposition that faces every man who does a great work, and the slowness of Congress to support him is an astonishing revelation. Here is a body of intelligent men elected for their grasp of national affairs, who falter when it comes to the completion of the task begun by themselves twelve years ago.

This article is intended to deal mainly with engineering, and it will therefore be more appropriate to refer to the reorganization later after having investigated in as much detail as will be permitted, how engineering has fared in the navy since 1900, while it has been in the hands of a corps whose duties include navigation, seamanship, gunnery, engineering, and the general executive direction of the ships as a whole. In other words, has the Personnel Bill of 1899 accomplished what its authors hoped?

We must remember that the chief cry against the new legislation related to specialization, and it was constantly stated that "no officer can be everything on board ship." The fact was entirely lost sight of that the bill passed by Congress never contemplated anything of the kind. It was a method of placing engineering on an adequate footing in the navy—in fact, of exalting it as a profession; and, best of all, of affording the Navy Department a means of selecting technical men from a much larger number of officers who had shown in service their special fitness. There is ample room in the one corps, having charge of executive work and the operation of machinery, for any amount of specialization as the officers show aptitude for it. Formerly, the engineer corps of the navy was selected by the appointment of cadet engineers at the Naval Academy, all of whose careers were to be in the technical corps. Later, the engineer corps was recruited from the cadet midshipmen at the Naval Academy, most of whom tried to avoid it. Now every officer has an engineer's education and every one must go through an apprenticeship in engineering.

The provisions of the Personnel bill seemed unsatisfactory at first for several excellent reasons. In the first place, it had accomplished

in one stride the advance from an inadequate organization developed in the centuries under sails, to a modern system under which a battleship is treated as a great power plant for war purposes. The transition could not have been made without confusion, under any conditions, and the suddenness of the change was like upsetting the whole Service. The navy of sailors could never become a navy of engineers simply by Act of Congress. Much had been done at the Naval Academy to pave the way for a change, but nevertheless it was too quickly accomplished to work smoothly.

In the second place, there was a great scarcity of officers for a number of years after the Spanish War. All available officers were taken out of the engine room and placed on deck, to the detriment of engineering. No deck officers were put below to learn machinery and to fit themselves to take the places of the older engineers.

In the third place, it was unfortunate that the officers into whose hands the new organization fell were either lukewarm or distinctly opposed to it. They undoubtedly tried conscientiously to do their duty, but they were scarcely qualified to look things straight in the face and to carry out a plan demanding high enthusiasm. The consequence of this attitude was that in engineering matters the navy drifted for five or six years, and the criticism against the outcome of the Personnel Bill was entirely justified. It looked for a while as if the Department would be obliged to employ civilian engineers or to extend the duties of the corps of naval constructors to the design, direction, and management of machinery. That time has, however, passed by and the past four years have demonstrated the capacity of the line to cope with the whole question.

It is not to be inferred from what has been said above that the navy has not been able to carry on its duties effectively. Mistakes were made that might have been avoided under a wise administration and some serious accidents resulted; but the wonder is there were so few. The repair bill was high; but again, that naturally followed an enormous extension of power. When one contrasts a modern battleship, having one hundred or more machines and twenty-thousand or more horse power, with the fighting frigate which contained just power enough to get out of its own way, one has reason to expect a greater repair bill.

While the officers of the navy had, on the whole, favored the passage of the Personnel Bill in 1899, it is probable that the majority had comparatively little faith in that provision which united the engineers and line into one corps. The doubt was not entirely removed until the battleship voyage around the world demonstrated that ships

could be taken on long voyages without breakdowns; that the same corps could navigate and propel these ships without serious hitch. This proved conclusively the possibilities of the new organization.

To return to the "age of specialization" argument, it must be remembered that this is an engineers' navy; as Mr. Roosevelt said, every officer is a "fighting engineer." It must furthermore be frankly recognized at the Naval Academy that the fundamental part of the education for all executive officers is some form of engineering, and the officers have been quick to give this recognition. Every midshipman has the same general preparation up to the time of his commission, and there is ample opening for all the specialization he wants on board ship and in the navy yards, so that the claims for specialization are fully met.

Engineering in the Service may be divided into two parts: that which is done on shore and that which is necessarily confined to a ship in commission. The latter requires an organization exactly similar to that of any large power station, with the addition that it is for war purposes. If the staff managing a power station were required to design and build its own machinery in addition to operating it, there would be an excellent parallel between the conditions on shore and those on board ship.

Another division of engineering is into four parts:

1.—The design of ships and machinery, including guns, propelling engines, and all accessories.

2.—Construction.

3.—Operation.

4.—Maintenance and repairs.

The first and second of these are carried out entirely on shore. The third is purely a sea-going business, and the fourth may be either.

The repairs to the hull and fixed parts of a ship must commonly be done at a naval station. The repairs to machinery, so far as possible, should be done on board ship by the crew, to the end that a fleet of ships may be self-sustaining in foreign waters. The general overhauling and extensive repairs in fitting for sea are necessarily a navy-yard operation.

The orders issued by Secretary Newberry during his very brief term of office, reorganized the navy yards by placing all work under the immediate management of a naval constructor. This was a distinct improvement. The old system of having as many heads as there were Bureaus at the Navy Department, with very imperfect co-operation, was wasteful and slow. Furthermore, it was used as a means of giving officers shore duty, not selecting them for their special ability but because it was their turn to have relief from sea service.

The managers for the yards were taken from the corps of naval constructors for several very good reasons. Of course all their work was subject to the approval of the commandant who is a line officer. By Mr. Newberry's order the former heads of departments became simply inspectors of work done under the direction of the works manager. This system seems at first glance an excellent one, but as a corollary it gave the general direction of all repairs and construction, as well as design, to the Bureau of Construction. No doubt the argument which appealed to Mr. Newberry was a perfectly valid one. Here was a corps of officers selected from honor graduates of the Naval Academy, specially educated in post-graduate schools at home and abroad, and always available for shore duty. They had demonstrated in the upbuilding of the modern navy a high order of ability, and, on the whole, they had been successful.

But, with all the arguments in favor of the new system, [promulgated over night,] granted, the organization was too hasty and its effect was to throw out of work, and effective control of work, a large number of men fully as able to direct navy-yard operations as the corps of constructors. This naturally aroused intense opposition, and bade fair to rouse internal strife quite equal to that which continued for the thirty years preceding the passage of the Personnel Bill.

The work of the Service has a perfectly natural grouping under two heads: one, the hull and fixed parts of the ships repaired only in a navy yard or dry dock; and the other, the guns and machinery subject to constant wear and tear and repaired either on board ship or on shore. Mr. Newberry's order utterly failed to take into account the immense educative value of placing engineering officers directly in control of repairs to machinery on shore. A naval station is more than a manufacturing establishment; it is established for the purpose of enabling our ships to keep the sea, and the training of officers to do their work effectively at sea may be regarded as much a part of the yard functions as actual repairs and construction; otherwise, repairs might better be done by private ship-yards where much more construction is carried on than would ever be possible in a navy yard.

Another objection to the new order was that it established a divided responsibility. It was claimed in argument against this that the sea-going officers were made inspectors of the work done under the direction of a naval constructor and that they thus became responsible; but, it was at best the establishment of another link certain in a short time to prove weak.

Mr. Newberry's plan would undoubtedly have been better adapted to the conditions if his managers had been selected for special fitness

without regard to corps, and if all construction and repairs in the yards had been placed directly under an assistant secretary of proved executive capacity, instead of under one of the Bureaus. It would still have had the disadvantage of taking from sea-going officers the responsibility for their machinery. By placing all practical management under one corps of officers already in control of a very large part of the naval appropriation, a strong political machine was established which ultimately would have dominated every department of the navy, to the great detriment of effective control by the Secretary himself. This was perhaps the worst aspect of the plan, as any Secretary would have been helpless in the hands of a single corps having a great sum of money to distribute among the navy yards, especially as the members of that corps could not generally be ordered to sea duty. This has absolutely nothing to do with the personality of the corps which Mr. Newberry selected to take the management. Our corps of constructors is a first-rate body of officers, splendidly equipped to do important service for the Government, and their desire to obtain control of all the shops in the yards undoubtedly proceeded from a very sincere conviction of the efficiency to result; but they are human and they ought to feel the change wrought by Mr. Meyer as a measure in their own interest. Certainly it has saved them from the temptation incident to great increase of power.

Secretary Meyer went into office with an excellent reputation for efficiency in the Post-Office Department, but without previous experience in the navy. If any doubt existed as to his stamina in dealing with a difficult administration during a period of confusion and strife, that doubt has been amply removed. His fairness, good sense, and firmness on every question placed before him should give him the hearty support of every officer and the backing of Congress. It is astonishing that there should be any opposition to his plans. One of his earliest official acts was a frank acknowledgment of ignorance on technical matters by the appointment of a board to study and report on the organization of the navy yards. While holding to the concentration of work under a few heads, as established by his predecessor, he was placing himself in a position to carry that idea into effective operation without disrupting the entire service. The finding of the board was a perfectly simple one, viz., to create two departments in every yard for construction and repairs —one for the hull and the other for the machinery—both under the responsible control of a well selected commandant. This was carried out by the Secretary. He simply left the hull work under the

constructors and he placed the repairs to machinery where they belonged, in the management of sea-going officers.

The next step was not strictly engineering as it related to a better system of keeping accounts. It is not necessary to refer further to it here as an entire paper would be required to state it fully.*

The third step related to the bureau system at the Navy Department, recommendation being made to Congress that the Bureau of Equipment be abolished and that its work be divided amongst other bureaus. A bitter fight followed this recommendation, as the Secretary, after investigation, had decided to place a large part of the electric machinery under the Bureau of Steam Engineering, whereas the Bureau of Construction wanted it. There is something almost grotesque about this squabble amongst serious-minded officers, as either bureau was amply competent to install it. Neither, in the nature of things, could have much to do with its manufacture, and the Secretary showed his good judgment by giving its selection and installation to the officers who were going to operate it.

The fourth step taken by the Secretary was the appointment of four aides to advise him on all matters pertaining to the service. The only one of these concerned directly with engineering was the aide on materials, and Mr. Meyer's obvious intention was to obtain advice from an experienced officer on the conflicting claims of bureau chiefs. The system of settling these claims was, at best, a makeshift, as it simply referred them for adjustment to a board consisting of the officers who made the claims. This arrangement in a military service is bad in theory and practice, and the proposition to have a single officer of proved ability pass on recommendations where there is conflict between different bureaus, is an excellent one.

The Secretary's trouble began with Congress. Those measures which he could carry into effect by the President's authority were quickly ordered, but it was only after a hearing and much discussion that Congress gave a grudging consent to a trial of his plans for one year, and although he can order the aides and give them definite duties in the Department, some legislation is required to make their positions effective. Congress does not seem inclined to grant this. The whole subject is once more up for consideration and the arguments will have to be made again. The Secretary's report shows at least that his plan has worked well for six months and that there has been a large resulting economy in naval expenditure. While it

*It is hoped to present, in an early issue of The Engineering Magazine, an authoritative review of the accounting system and its results.

may be doubted if the time has been sufficient to establish the latter point effectively, there is no question of increased efficiency throughout the service.

A complete new organization of the Navy has by Mr. Meyer's order followed the passage of the Personnel Bill of 1899, only ten years behind it, and while it will greatly improve the conduct of work in the navy yards, there is a more important question of the actual experience on board ship during these years. The management of machinery, or that branch of engineering which comes without question under the sea-going officers, is of overwhelming importance. Repairs may be done on board ship, but they can also be done at private ship-yards as well as in the navy yards. Hence the organization for handling and fighting the ships transcends everything else. We have had eleven years of experience with machinery since the passage of the Personnel Act. On the whole it has worked well and officers generally are satisfied. The first need seriously felt as the older engineers dropped out, was for designers of machinery and for highly trained technical men to direct the construction of machinery, all of them selected from the line of the navy. This need has been supplied by another of Secretary Meyer's orders in the establishment of a post-graduate course in engineering at the Naval Academy. Ten officers are selected every year and the course covers two years in all branches of engineering commonly practiced at sea. There are thus twenty officers under instruction at the Naval Academy. The first class of ten was selected in the fall of 1909 from about two hundred applicants for the instruction. From these classes two will be taken every year for designing machinery and superintending its construction. The course of studies is highly practical, including the summers spent in the inspection and study of industrial processes at various large commercial establishments. While the space of this article does not permit a statement of details, it may be said that the course covers a consistent study of engineering and time is found for lectures by a number of experienced civilian engineers, manufacturers, and teachers.

The Naval Academy is thus brought into closer contact with other branches of engineering than that pertaining strictly to the navy, and it is broadened out somewhat. More can be done in this way for the midshipmen as well as for the commissioned officers. This post-graduate course is new, but in connection with the experimental station at Annapolis and with the navy yards, there is no reason why it should not develop a body of trained engineers for all contingencies.

Attention has been called to the argument against placing the

management of machinery on board ship in the hands of the line—that corps which is also responsible for deck duties and the general management of the ship—as acting contrary to the tendency of modern industries. Specialization is certainly the tendency of the day. It is required in the trades and, what is more, it is thoroughly practiced in the enlisted force of the navy. So far as the officers are concerned, it is highly important that every one of them should qualify in practical engineering after graduation. Everything on board ship requires the control and operation of engines. There is absolutely no reason whatever why the qualifications that enable a man to direct and care for the machinery of a gun, or of a dynamo-room, should be any different from those required in managing the propelling engines—both require the same kind of specialization and the same man can do both. This does not change the fact that some men will operate guns better than others and that some will do best in the engine-room; the choice can be made by them. But, inasmuch as their fundamental training has been the same, they can, without any jar on the present scheme for specialization, belong to the corps which commands the ships. A slight examination of the records during the past few years will demonstrate the complete success of the present organization. In the matter of coal consumed on board ship, it may be assumed that lack of efficiency would appear in a much larger coal bill, yet the past few years have shown a steadily decreasing expense.

A brief table of three classes of ships affords a very fair comparison in this respect. They are all figured on the coal per indicated horse-power, thus eliminating the size of the ships and their speeds from consideration. There are three classes set down in the table on page 684. The first represents the average for ships commissioned during the past five years; the second for those commissioned in the 90's; the third for those of the 80's.

It is only fair to state that the machinery for all these ships was either designed or inspected by officers of the old engineer corps, but the ships of the first group have been operated entirely under new conditions by line officers who certainly show no falling off in the economical expenditure of coal. One of the most effective systems for promoting efficiency in this regard is the offering of prizes for economy of coal and efficiency in the engine-room department. This began on the battleship cruise around the world. It encourages the same zeal in the fire-room as is produced on deck by prizes for the best target practice.

It is difficult to make reliable comparisons on the cost of repairs

to machinery and boilers. Testimony before a Congressional investigating committee on the merchant marine shows that the annual cost of repairs to machinery on merchantmen exceeds 9 per cent of the value. Expenditure for similar purposes in the navy is only 2 per cent of the value. This great difference is probably due to the fact that the enlisted force can do a large part of the repairing on board ship, in which case no charge for wages is made. The warrant machinists are leading men for the repairs which are always under the supervision of an officer.

| | Coal per i. h. p. | Speed. |
|---|---|---|
| SHIPS OF 1905-1910. | | |
| North Dakota | 1.739 | 21.66 |
| Flusser | 1.923 | 30.41 |
| Michigan | 1.690 | 17.95 |
| South Carolina | 1.395 | 18.86 |
| Birmingham | 1.932 | 24.32 |
| | 1.736 | |
| SHIPS OF 1890-1900. | | |
| Indiana | 2.023 | 12.08 |
| San Francisco | 2.03 | 19.52 |
| Oregon | 2.150 | 16.791 |
| Olympia | 2.190 | 21.68 |
| Baltimore | 1.707 | 20.09 |
| | 2.015 | |
| SHIPS OF 1880-1890. | | |
| Chicago | 2.63 | 15.13 |
| Concord | 2.76 | 15.8 |
| Dolphin | 2.19 | 15.5 |
| Boston | 3.11 | 13.8 |
| | 2.67 | |

Another statement which illuminates this side of the question is that the total engineering expenses in 1907 for each horse-power in the navy, were 6.04; in 1908, 4.39; in 1909, 4.31; in 1910, 3.97. The coal for steaming purposes per knot including tugs, colliers, and torpedo craft was: 1907, 1,027 pounds; 1908, 801 pounds; 1909, 755 pounds; 1910, 740 pounds.

The casualty list and break-downs cannot easily be compared with the same things in the old navy, or under the old system of a separate engineer corps. The ships are so utterly different and so vastly greater in power that there is no basis of comparison. The chief casualties have been in connection with the guns where the line officers are supposed to be experts. The explosion on the Bennington has often been quoted as a result of turning machinery over to amateurs, and doubtless there was some lack of efficiency on that

ship. The organization was probably bad and the officers did not look after their work as they should have—but that might occur under any system and has occurred before. Without any data beyond a list of the casualties that have occurred in recent years, one would be fully justified in saying that casualties have lessened. Especially is this true if taken in proportion to the amount of machinery placed in the hands of the officers.

One of the features of the new administration is a confidential bulletin issued by the Bureau of Steam Engineering to give officers in ships scattered over the world definite information on all kinds of subjects pertaining to engineering. The following is taken from one of these bulletins to show in a general way the organization for carrying on work and for operating the machinery. It is that worked out for the battleship *Michigan*:

The senior engineer officer is responsible for the management, maintenance, and care of the machinery. He supervises everything under these heads. Every part of his duties is delegated to some one else to attend to so that he may be free to see that the others do their work, and do it properly.

This, of course, does not mean that the senior engineer officer fails to make any of the inspections, reports, etc., called for by the Regulations.

The assistant to the senior engineer is a lieutenant regularly assigned to engineering duty. This officer aids the senior engineer as directed, takes charge of all work going on in the engineer department, in port, and does such watch-standing duty as may be assigned him.

The chief machinists and machinists do not keep watch nor day's duty, but devote themselves to the care and maintenance of their stations and endeavor to keep them at the highest state of efficiency.

Midshipmen are assigned to the engineer division for instruction. They perform watch-standing duties as required, write reports of work performed in the engineer department, write descriptions of machinery as directed, and carry out the prescribed course of instruction.

Watch-standing officers stand regular watch under way and perform day's duty in port. These watch-standing officers do not form part of the engineer division except for watch standing. They are commissioned officers. During the forenoon of such days as drills take place requiring the presence of the officers on watch, the assistant to the senior engineer takes the entire forenoon watch. This is, generally, every day except Saturday and Sunday. The assistant frequently takes a night watch at sea.

A daily employment list is made out each day and is placed in the office at the close of the working day. It shows the employment of every man in the engineer division. In case the man is employed on repair or overhauling work, the number of the work item is placed opposite his name. In other cases, his condition is noted by symbols indicating that he was sick (M); on station (S); cleaning bilges (B); on watch (W); absent with (L) or without leave (A); confined (C); at drill (D); in a working party (P); performing extra duty (X), etc.

A case is filled with cards arranged alphabetically, with a separate card for each piece of machinery in the ship. In another case are kept records of each item of work done, arranged in numerical order.

Work is originated by the senior engineer officer, by his assistant, or by the machinist in charge of a station. If an item of work originates with the senior engineer, a memorandum of the work to be done is made out in the job-order book and sent to the assistant. The assistant has it entered on the daily-employment list of the machinist concerned. The same method is pursued if the work originates with the assistant. If a machinist in charge of a repair station originates the work he makes a request for permission to do the work and for assignment of an item number, using a printed form supplied for the purpose. The request is passed upon by the senior engineer and by his assistant, and, after it has been approved, the yeoman prepares a record-item card and puts it in the box for work in progress and not completed. This same method is followed for all repair work and for periodical overhauling.

When an item of work is completed a rough description is filed in the office by a midshipman, after consulting with the machinist under whose charge the work was done. This description embodies:

(1) The reason for the work.
(2) The condition in which the part was found.
(3) A full account of what was done.
(4) Tests made and witnesses.
(5) The names and hours of employment of all men employed.
(6) The dates of beginning and finishing.
(7) A list of all stores used.

These reports are examined and corrected by the assistant and then are typewritten on the record-item card. This card is then filed in its regular numerical order, but the work is indexed on the cards in the alphabetical machinery list. There are about 1,000 cards in this machinery list on the *Michigan*. By examining any one of these cards reference is given immediately to every item of work done on that particular piece of machinery since the delivery of the vessel from the builders.

Navy yard work is carded and indexed in a similar manner, but with record cards of a different color.

For keeping track of routine tests and inspections, printed forms have been prepared on the *Michigan*, showing those tests that must be made weekly, monthly, quarterly, semi-annually, and annually. These forms are filled out by the machinists, who keep copies for their own use. For the large items, separate numbers are assigned.

For stores, a card system is used with cards of different colors for Title "Y," for Title "B," and for "spare parts." The class number is written in on a tab on the top so that it is easy to check up the class cards. A separate set of cards is used for the class ledger. The original vouchers are used instead of an expenditure book or bill book, in order to save work. The store cards are arranged alphabetically, and little metal guides are put on those that have articles to be placed on requisition.

The forms used in this system are as follows:

(1) Memorandum for senior engineer officer, from machinist in charge of repair station, reporting work that should be done on his station and requesting the assignment of item numbers.

(2) Record card of work done. This card includes features already described and a reference to any correspondence there may be upon the subject.

(3) The same as (2) except of a different color. This card is for work done at a navy yard.

(4) Store cards, of different colors for different titles, with tabs to show classes. These cards show name of article, where it is stowed, the ship's allowance, and also voucher number and date, quantity, unit, and total cost, and place from which received.

(5) Class store cards. Those show voucher number, date, and amount for receipt and for expenditures. Only as many of these cards are required as there are classes.

(6) Bunker inspection form. This shows the bunker numbers and capacities and leaves blanks for amount on hand and date.

(7) Employment report. This shows actual employment of every man on a station for every day during a week.

(8) Periodical tests and inspections. These are prepared separately for each repair station and, as before described, for each period—as weekly, monthly, etc.

(9) Memorandum reports for log showing work in progress and tests or inspections made for each station. These reports are made by the machinists to the officer of the watch.

(10) Station billets.

(11) Ice-machine log.

(12) Evaporator log.

(13) Auxiliary watch list.

(14) Water log, showing amount of water on hand at midnight in each boiler and tank. If stores are obtained, the item of the work must be given the storekeeper.

When requests for repairs are submitted, they are accompanied by a complete copy of all record item cards referring to the machinery for which repairs are requested. In this way considerable assistance is given to reviewing officers, and it is easy to show that a request is not unreasonable.

When some such organization as that above outlined is fully established on all our ships, the engineer force will be up to date; but time is required and criticism should take into account that officers in the navy are dealing with the same problem that all industries have had to face. Consolidation for greater economy and efficiency is the watchword throughout the whole country, and the navy question is only one phase of it. The Secretary of the Navy has taken it up seriously in all departments, and the members of Congress should not permit any internal feuds among naval bureaus to delay definite and wise action. A great piece of work for the personnel of the navy was accomplished by the House Naval Committee in 1899. Now let Congress bring the seed then planted to full fruition in equally important legislation for the navy yards and for the Department as a whole. Of one thing the people of the United States may be certain: their ships are not going to be allowed to fall off in power and efficiency so long as the officers (whatever corps they serve) are permitted to do their work without political interference.

# MONOPOLY AND PROGRESS.

*By Dr. Franz Erich Junge-Hermsdorf.*

## II. CONCENTRATION AND EMANCIPATION OF CAPITAL.

In a series of three articles, of which this is the second, Dr. Junge brings unusual faculties of observation and analysis to bear upon existing industrial conditions in the United States. He views affairs with the double advantage of an intimate acquaintance with the engineering industries and an external perspective of American economic policies and tendencies. His criticism will be made constructive by a presentation of available measures for betterment as proved by the experience of other lands.—THE EDITORS.

WITH due respect to the older definitions of the term, and in view of the changes attending the evolution of industrial society in the mean time, we define capital as the means affording their possessor a competency in the lean years and a special opportunity for profitable production in the fat years. While, in most cases, it is our inborn ability, physical or mental, which enables us without expensive education to secure a position as wage earner somewhere in an agricultural, commercial, or industrial establishment, we know quite well that it is only by the investment of capital, of accumulated or inherited fortune, that we can become stockholders or partners in those establishments, thus reaping a surplus benefit from the toil of others.

The presence of capital in a commonwealth, however democratic may be its constitution, is bound, sooner or later, to create privileged classes, enabling them to conduct enterprise on a large scale, and, by attracting a larger and larger part of the sources of production, to gain control over men and affairs. Nor can this function of capital be regarded as harmful to the commonwealth, as long as the money is kept circulating through the exchanges of the country, serving as a fertilizer and stimulator of national progress. But certain it is that the evolution of industry has strengthened the plutocratic form of government quite as much as slavery once aided in the upholding of feudalism. It is chiefly by replacing human labor by mechanical means, by cutting out to a large extent the personal element in production, and dealing with quantities and values never dreamt of before, that capital has succeeded in subordinating everything to its dictum. So today, individuals are beginning to dread the power of capital for the same love of liberty that once made them dread the power of government.

Speaking of "the *power* of capital," it is necessary to get a clear understanding of its meaning and to give a few data showing to what extent wealth is concentrating and gaining control over the United States. The returns of the new Census not being available, we have to base our conclusions upon the results of private inquiry. John Moody and Sereno S. Pratt, both high authorities on financial matters in the States, maintain that, while there are a number of other large groups in special lines, there are actually only two influences that dominate immense areas in all lines, transportation, public service, industrial, financial, banking, insurance and so forth. These interests are centered in the Morgan and in the Rockefeller group, respectively. While the Morgan interests represent a capital of nearly ten billion dollars, which is equivalent to nearly 10 per cent of the entire estimated wealth of the United States at the present time, the Rockefeller interests represent an even larger aggregate of capital. It will be a matter of few years only when one will be more or less completely absorbed by the other, and a grand close alliance will be the outcome of conditions, which, so far as human foresight can see, can logically have no other result. Outside of this central group are half a dozen smaller ones which probably represent a further corporate control of fifteen billions of capitalized values. But these smaller groups are identified either with the Morgan or Rockefeller part of the group, so that we may fairly state that the capitalized valuation of probably thirty-five billion dollars is concentrated in the hands and under the control of not less than a dozen men.

Says John Moody:

> A careful estimate of the corporate capitalization now existing in the United States indicates that, outside of small close business corporations owned by individuals, the total corporate capitalization in par value in the United States at present is not over $43,000,000,000. The wealth of the United States, according to last reports, was in the neighborhood of $110,000,000,000, of which about 50 per cent was represented by realty values, the balance being tangible property of thousands of different kinds. So that we see, after all, that the trend towards concentration in corporate control has now extended so far that approximately 80 per cent of all the vital corporate capital of the country is under the domination or control of this powerful group of Wall Street interests which we have referred to.

Of course, there is the old theory that, corporations being composed of a number of individual shareholders and representing an approach towards the socialism of private enterprise, the corporate wealth of the country is distributed over a fairly large percentage of the population. Yet, taking seventy of the leading corporations of the Union, it is found that in railroads not more than

288,000, and in industrial companies no more than 338,800 shareholders are interested. Of these shareholders, it must be remembered, only a small percentage is represented by individuals. Thus, for instance, of the $17,500,000,000 of railroad stock now outstanding in the United States nearly 30 per cent is held abroad, nearly 20 per cent is owned by the railroads themselves: to banks other than savings banks is credited about 6 per cent, to insurance companies about 4½ per cent, and to savings banks nearly 4 per cent. Altogether, 65 per cent of the total is thus to be accounted for as not owned by individual investors living in America. And, taking the wealth statistics of the Tenth Census, it is found that 0.3 per cent of the American people owned 20 per cent of the wealth, 8.97 per cent of the people, 51 per cent of the wealth, and 91 per cent of the people only 29 per cent of the wealth. For comparison I give the corresponding figures from Germany, compiled from the official statistics by Professor Gustav Schmoller, of Berlin. It is instructive to see that in that country, which does not partake the blessings of a democratic *régime*, but enjoys the privilege of a paternal government, of the total wealth amounting to about forty-five billions, only 2 per cent is vested in the upper classes, 54 per cent in the middle classes, and 44 per cent in the lower classes.

Now, if we admit that capital in its lesser accumulations has been and is conducive to national progress—progress which must include, besides the physical and intellectual, also the moral uplift of man—why does it become dangerous and tyrannical and harmful to the country when concentrated in few irresponsible hands? There can be no doubt that capital and capitalism, based as it is on the institution of private property, has done an enormous lot of good to the commonwealth, as long as it concentrated its activities within the national borders, serving to multiply the values of the native soil. But when capital started to flow beyond the borders of its natural vessel—where it can be checked by competent authorities, and where righteous governments can direct its course to the best ends of all—and when it started to combine with other streams of overflowing wealth from other countries, capital became a wild torrent of formidable force, an *international* power, whose movements are feverish and uncertain and can no longer be guided by established national authorities. Nor are they balanced by weight of international agreement, because there is no arbitrary power strong enough to enforce conciliatory measures, and none elevated enough to enjoy general recognition. International capital is its own arbiter; it is responsible to no one, and its *suprema lex* is to grow and to multiply, ignoring sentimental considerations.

Nobody will deny that the highest aim of capital is to seek profitable investment regardless of national restrictions. And where can profitable investment be better attained than in undeveloped countries, for instance in Asia, having both cheap resources and cheap labor in abundance? Where can the products of such investment be more profitably sold than at home, in highly developed countries, having a high standard of monetary exchange, high life, dense markets, and purchasers able to buy? Spurring, as such investment does, the development of foreign industries, what influence will the emancipation and efflux of capital have on the conditions of the laboring population at home? Taking a concrete case: when textile goods, made in China with American capital, with Japanese machinery, and with Coolie labor, are imported into the United States, being sold on the inland market in competition with home-made goods—as they actually are on the Pacific coast—will this policy, profitable as it is to the capitalist, tend to increase the compensation and protection of the American workman? Will it secure to labor greater safety and stability of employment, will it encourage the creative class of men, the men with ideas, will it provide markets for their goods, and will it help to develop those high-grade products, which are hidden in the American soil, and which only high-class technical talent can lift to light? Surely, since foreign labor is admitted free of duty into the States up to this day, in order to keep wages on a reasonable level, the moneyed interests will find means to convince Congress that the *products of American capital* coming from other lands, must also be admitted free of duty to the American market. Will this natural and steadily growing trend of capital, to produce at low cost abroad and to sell at high profit at home, prove beneficent to national progress? As far as it is given us to see it will not. Rather will it tend to force all the smaller disorganized economic forces in the land, in all lands, to unite in some grand alliance against the oppressive might of capital and to organize their collective strength for the common welfare.

Says William Howard Taft: "A gigantic controversy between capital and labor will decide once for all how capital and labor shall share the joint profits which they create." From our analysis of the situation it will be more a fight between the legitimate power of national governments, representing the interests of the masses, and the arrogated power of international capital, representing the interests of the favored few. There is, indeed, a closer affinity of aims, a firmer alliance of action, traceable today between the great industrial trusts of the different countries, preying jointly upon the world's markets, than there is co-operation existing between the various social

strata of one and the same country. The world is becoming an open shop owned by the international association of manufacturers. National borders disappear, and with them all the loftier motives for which they stood.

But it is not only the subjugation of national ideals to international aims that is so much to be feared, but the fact that a small group of selfish men is able to swing, not only the factor of capital, but also the factor of government, setting up nation against nation, and hearthstone against hearthstone. Here is an illustration of this disastrous tendency as it exhibits itself in the commercial dealings of this very day: A small group of American capitalists known under the name of "North Trust," attempted, in times of disorganization of the German market, to buy up one of the fundamental resources of that country, making private contracts for the supply of 320,000 tons of potash per annum, on five years' option; thereby they would gain control of the American market, where about 360,000 tons are consumed annually, thus establishing a practical monopoly in restraint of trade. And this same trust is attempting, further, to engage and play the American Government against the German Government, because the latter has enacted a law (long ago planned and announced to the State Department in Washington), which purports, by the establishment of a national syndicate, to prevent over-production of potash and, for the benefit of the small producer, prohibits squandering irreplaceable resources, of which Germany has no plethora.

It is a most reckless game of concentrated capital, and one which cannot be too severely rejected before the forum of publicity—this attempt to endanger and disturb the friendly relations between two great peoples for the sole benefit of establishing an artificial monopoly on some such commodity and reaping excessive profits from its sale. But it is an instance which shows clearly that national communities must not let the control of capital slip from their hands, lest international complications of the gravest consequences arise, for which corporate capital will not and cannot be held responsible. It is the tragedy of our age, the way this artificial creature of capitalism, in its ubiquity, can forever escape the single justice which the natural individual must face. And it is the duty of every patriotic man, within the borders of his country, to see that the rule of capital is once for all subjected to the rule of government, viz., to the collective force of civic virtue evolved in centuries of nation building.

It is not my aim to throw the search-light of speculative thought on all the various aspects of capital as an international power. Nor do I underestimate, for one moment, the significance of trade and

commerce as a peacemaker, bringing the peoples of different countries into closer alliance, urging them to abstain from settling their disputes by organized force, for fear of endangering mutual investments, and even forming combinations for greater security and stability of industries and markets. I have only hinted at some of the *dangers* which arise when national Governments are replaced by international trusts. There is always this one fundamental consideration for advocates of private monopoly power and the rule of capital to keep in mind, as distinguishing between the trust of the few and the trust of the people:—

Government, the great partnership of the State, holding the total assets of society, is a legitimate and recognized authority, established by weight of historical evolution, carrying within it the sanction and inspiration of ages, being free from slavery to instant gain, possessing distance of vision unhampered by special interests, and swinging an instrument of moral force such as no private individual or combination of individuals can ever wield. The other alternative of commercial dealing, private monopoly, or the power of capital—though eagerly bent upon usurping and misusing the *privilege* of government—neglects to fulfill any of its *responsibilities*.

If, therefore, we take into consideration, beside the mere financial aspects of capital as a production factor, its economic, social and moral effects on mankind in general, its influence on eugenics, on the preservation and progress of nations in special, we shall invariably reach the conclusion that capital must be controlled by national Governments and be forced to work for the best ends of the national community, lest it may become a direct menace to the country that gave it birth.

Nobody can contest this argument:—that if the reward of a country's activity in form of wages, and the income from a country's resources in form of dividends, be invested abroad, the productivity of that country will fall short of its potentiality. Considering, in this relation, on the one hand the growth of financial obligation of the United States towards Europe (from which it borrows capital and labor in ever growing quantities), and on the other its waning trade balance; and taking notice, further, of the fact that prosperity in the United States already depends largely on the credit of American securities abroad—it is important to examine somewhat more closely the *rôle* which capital plays in the evolution of industries.

Omitting, at this place, discussion of the more financial aspects of the problem—amount, distribution, organization, and reward of capital in American industries—we confine ourselves to a brief illus-

tration of its genetic-technical effects. In his admirable essay on "National Efficiency," Harrington Emerson has enlightened us upon the economic bearing of industrial production. He has shown in several instances what losses accrue to the national prosperity of a country when quantity of product is placed before quality, immediacy of success before permanence, spasmodic impulse before organized effort. An old but ever interesting argument advanced by political economists will help to emphasize what influence progressive manufacture exercises on the expansion of values gained in a country.

"A pound of cotton, costing at the time this calculation was made (1874), but 13 cents, has been developed into muslin which sold in the market for 80 cents, and into chintz which sold for $4.00." No mention is made here of the far greater values contained in knitted and embroidered fabrics and similar goods, of whose importance for the national industry Schedule I of the new tariff law gives convincing evidence—rates of duty ranging as high as 60 per cent *ad valorem.* Or taking the other important raw material, iron ore: "Seventy-five cents worth of common ore has been developed into $5 worth of bar-iron, or into $10 worth of horse-shoes, or into $180 worth of table knives, or into $6,800 worth of fine needles, or into $29,480 worth of shirt buttons, or $200,000 worth of watch springs, or $400,000 worth of hair springs, and the same quantity of common iron ore can be made into $2,500,000 worth of pallet arbors." And turning to modern times we note again a trace of paternal, because thoughtful, policy on the part of the United States Government, in the make-up of the tariff law, which favors the importation of raw materials but restrains the importation of finished goods, while those machines that serve to encourage the establishment of high-class industries are admitted free of duty.

Or, taking the next important material, coal, which in the United States is almost wholly treated as combustible fuel, instead of being, as it should be, treated as raw material forming the basis of innumerable products. Assuming that the coal contains 5 per cent ash, 20 per cent volatile matter, and 75 per cent pure carbon, we obtain from one ton of coal in the by-product coke oven 2.5 kilogrammes sulphuric acid or 9.7 kilogrammes sulphate of ammonia, 25 kilogrammes tar and the products thereof, 4.5 kilogrammes benzol and 135 gas-horse-power hours; while the remaining 750 kilogrammes of coke, together with the ore in the blast furnace, yield 800 kilogrammes pig iron, 1,000 to 1,500 kilogrammes slag (used for making cement and bricks), and 600 gas-horse-power hours. It is evident, therefore, that when coal is burnt directly in the furnace all the valuable by-products are lost to

the national industry—and it is further evident, from this technical deduction, that capital which shrinks from financing inland enterprises of a higher order, involving risk, and prefers to settle in the more profitable (because established and broadened) channels, producing raw materials or half-finished goods, or staples of some kind abroad, is far from conducive to national progress. We may substantiate our former argument, therefore, by saying that capital, being the product of the industries of a country, must again be invested in that country's industries, in order that the people may have employment and be encouraged to strive on.

Now if by legal action we can move capital to seek investment in the home industries, thus serving to build up the inland market, we are confronted by another question, quite as important as the first: Is the modern form of capitalistic organization, concentration of production and elimination of competition, favorable to industrial progress? Even if we were to admit that the world's productivity is governed by the "inexorable law" of supply and demand, it is evident that the mutual relation of these two factors has been entirely altered, even reversed, by the evolution of industries. While in former years needs and necessities actually did exist, and individual wants were met by the supplier—who had to conform his output to the taste of the purchaser—it is the merchant today, the manufacturer, the enterprising capitalist who, by show and advertising, incites desires, awakens needs, changes luxuries to comforts and comforts to necessities, in order that he may profit from the sale to consumers.

Goods are made, not to order, but ready for use; fashions are dictated by manufacturers; and markets, if not available, are drummed by agitators and salesmen. Supply precedes the demand, production outweighs consumption. The price of commodities is no longer the *natural resultant* of these two forces, but is an *artificial entity*, fixed by the storing power of capital. The ability of capital, by means of money and machinery, to buy up and retain goods at will (for example, to purchase and preserve practically the entire supply of some commodity at far less than its actual value), has placed markets and consumers at the mercy of capital. Says Dr. Arthur Twining Hadley:

> For at least fifty years we have been developing our skill as producers much more than our intelligence as consumers. We have been increasing our industrial output without correspondingly improving our civilization. I wish I could feel sure that the wisdom with which we spend our money had increased correspondingly. Intelligent consumption is a neglected art. The individual buys, not what he wants, but what he sees most prominently advertised. . . .

We note then, as a direct result of the reign of chaos or extreme

individualism which set in with the change of the Washingtonian to the Jeffersonian principles, a reversal in the mutual relation of the chief factors of industrial production, which was accelerated, even, after the close of the Civil War, by the opening of the South. Grown on the basis of free competition, capitalism succeeded soon in gaining unrestricted sway over the affairs of the country and, today, has almost reached the limits of its usefulness as an instrument of national progress, thus negating its own existence.

Large-scale production has entirely altered also the *social* conditions of industrial enterprise. I quote William Clarke:—

> The old personal relation between the workers and the employer is gone; instead thereof remains merely the cash nexus. To secure high dividends (for his employers, the stockholders) the manager will lower wages. If that is resisted there will probably be either a strike or lock-out. Cheap labor will be, perhaps, imported by the manager, and if the work-people resist by intimidation or organized boycotting, the forces of the State (which they help to maintain) will be used against them. In the majority of cases they must submit.

Not an unfair picture of the relation of capitalist and workmen today. We do not go so far as to say, with the Socialists, that there must cease to exist an idle class of society, whose economic function is simply to furnish capital and live on the interest. We do not say either that capital must be held and operated collectively for the equitable good of all. But we do say that *capital must be the servant, not the master, of the national community.* With conditions as they obtain today—in the United States more so than anywhere else—the mere *forms* of freedom (of competition) remain, but monopoly renders them nugatory.

Monopoly, the great discourager of effort in trade, manufacture, and profession, will dictate the technical methods to be followed, thereby suppressing individual aspirations. A few great corporations will buy up the highest grade of human talent, inventive, literary, mechanical, and will keep it latent or, at least, barren of creative work—as long as people are content to put up with "standard goods." There is no alternative left to unsatisfactory dealing. The "free" people in America not only must buy what manufacturers deem profitable to sell on their protected market, but they must pay any price which the combination of dealers agrees to charge. In fact, the prices which consumers have to pay for their goods in the States are, on the average, 15 per cent higher than are those at which the same class of goods is sold abroad. Nor is their quality any better. On the contrary, they must often pay the highest price for the poorest service.

This deplorable result, though it cannot in justice be generalized, is certainly the direct opposite of what scientific progress, in a demo-

cratic community, should bring about. And here is where this lamentable plague of commercialized endeavour is again wedded to the prime cause of capitalism and monopoly, which is threatening us today in all progressive countries. The technical forces in industrial production are being overruled by the financial forces, by greed, ignorance and the rule of thumb. The commercial success of an enterprise on the levelled markets depends far more on the ability of the sales department than on the real economic, technical, artistic merits intrinsic to the products thereof. There is no management so alert, so watchful, so free from slavery to instant gain, that it can direct the affairs of our gigantic modern combines in the way of intellectual, social, uplifting effort, away from worship of mere wealth.

Summing up we may say: While value and quality of goods grown in the hot-house of private monopoly need not of necessity be inferior, and may in some instances be superior to others, their competitive strength on the world's markets will in most cases be lower, and their price on the home market higher, than they would be under a natural competitive *régime,* which brings out the best in civilization and man and, certainly, seems the only *régime* tolerable in a democracy. But as competition led to over-production and therefore to the cutting of profits among capitalists, it had to be replaced by corporate business, by the concerted action of wealthy individuals and, finally, by the rule of private monopoly which, today, is the only "adequate rule" in the American Commonwealth. Nevertheless it is not adequate to protect the country against waste and corruption, against depression and panics, afflicting business every four or five years to the detriment of the people.

Do the pioneers of *progress,* do engineers, do artists, do literary men, do all progressive workers, realize that the monopolistic order of society established today contains in itself all the dangers against which the fathers fought? That private monopoly is the source and sustenance, not only of bad government but of national stagnation, and if permitted to continue still farther must ultimately destroy the very foundations upon which the commonwealth rests? Are we aware of the fact that our professions, by the rule of monopoly, are being degraded to a pitiable rank; that we are becoming the eunuchs of a hybrid civilization, the tools of *mammon,* which in its morbid zeal for uniformity, for tonnage, for immediacy, is reducing the whole world to one dead level, stifling originality, quenching individuality, crushing out the most wonderful of faculties—the creative faculty of man—beyond a possibility of resurrection, and forcing every one of us to fit himself to its Procrustean bed!

# THE NEW ERA IN ELECTRICAL ILLUMINATION.

*By Rollin W. Hutchinson, Jr.*

## III. GLOWER AND VAPOR LAMPS.

Mr. Hutchinson's review of modern illuminating equipment, from the viewpoint of installation and operating qualities, efficiency, and relative cost, is addressed primarily to the user and consumer. He began the discussion in our December issue with a study of metal-filament lamps. The January portion dealt with luminous and flaming arcs. The present part concludes the series.—THE EDITORS.

THE Nernst Lamp, which is now too well-known to warrant detailed discussion, is essentially a "glower" lamp, but it has some of the characteristics of the enclosed-arc lamp in that its operation is partly thermal and partly electrolytic. As manufactured at the present time the glower consists of a combination of the rare earths of volcanic production, including zirconium, woehlerite, gadolinite, euxenite, yttrotitanite, yttrocerite, samarskite, cyrtolite, aloite, endialyte, polykras, and kataplite. Nernst lamps are constructed in either single-or multiple-glower form.

Westinghouse-Nernst lamps are made in six units for use on both alternating and direct current of 220 volts, and three units for both alternating and direct current, 110 volts; for indoor and outdoor service. These are commonly termed 88- 110- and 132-watt single-glower, two- three- and four-glower lamps.

The normal range of operation of standard glowers varies from 200 to 260 volts for 220 volt ratings and 100 to 130 volts on 110-volt rating. The adjustment of Nernst lamps for use on circuits of various voltages is effected in the holder, and merely requires the employment of different glowers.

The efficiency of Nernst lamps increases with the number of glowers (up to the number of glowers practicable to use) because of the higher temperature gained from the closeness of the lighting units.

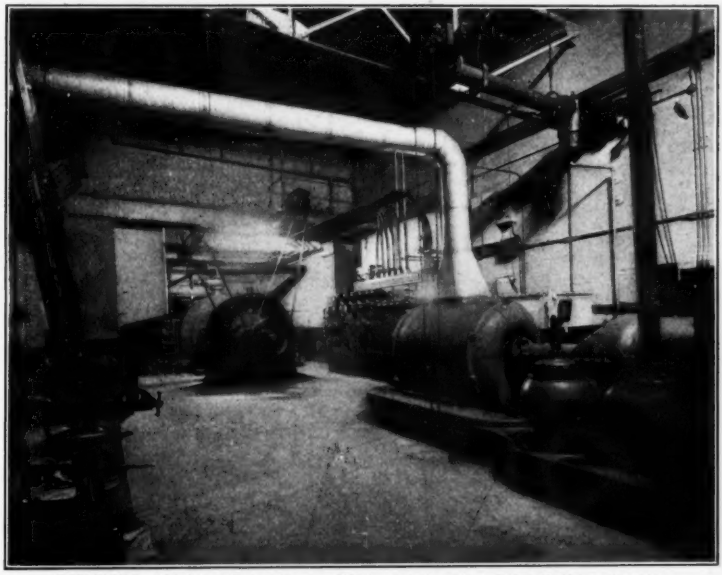
### COLOR AND DISTRIBUTION OF LIGHT FROM NERNST LAMP.

The color of the illumination from the Nernst lamp is a pearly white, yet it possesses sufficient softness and warmth to render it very serviceable for a variety of illuminating work. One of the most notable installations of Nernst lamps in America is that of the large department store of Marshall Field & Co., Chicago, in which 6,000

TYPICAL WESTINGHOUSE NERNST ILLUMINATING INSTALLATION IN A MUSIC STORE.

A SIOUX FALLS DEPARTMENT STORE LIGHTED BY WESTINGHOUSE NERNST LAMPS.

Nernst lamps of various sizes are employed, mainly of the two- and three-glower type. This installation replaced nearly 58,000 incandescent electric lamps.

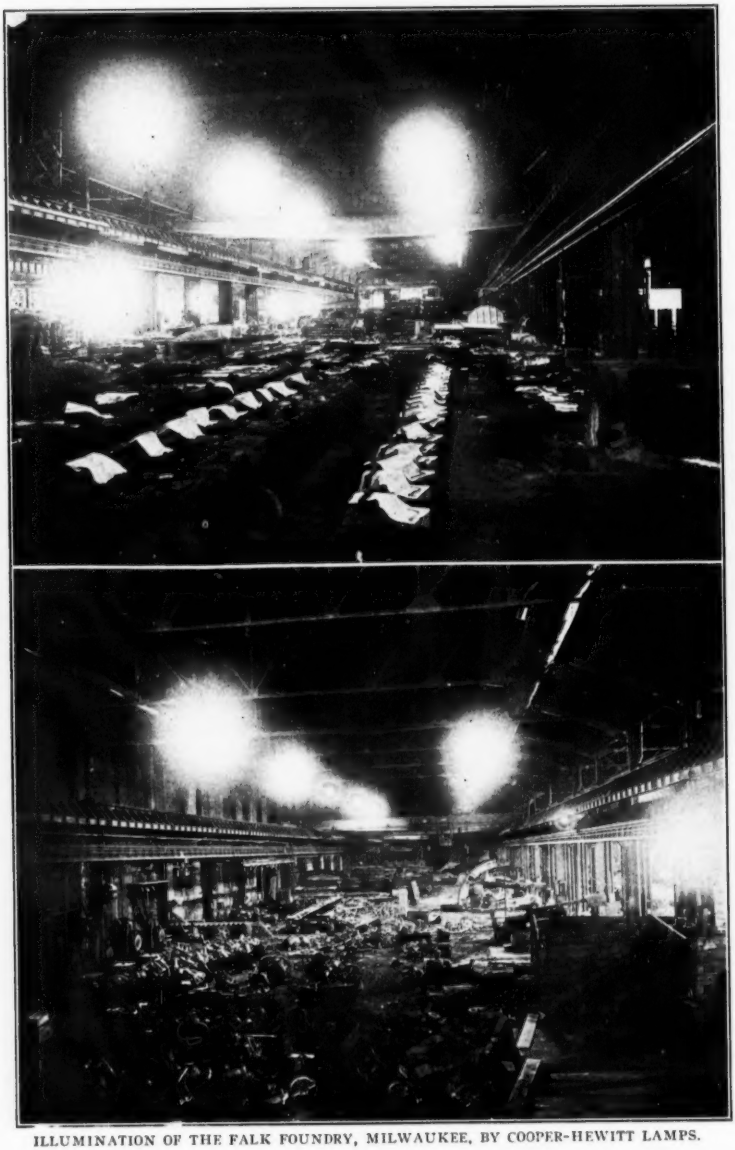


EFFICIENT ILLUMINATION OF A POWER PLANT BY COOPER-HEWITT LAMPS.

The Nernst lamp has been developed with a view of making its maximum intensity of illumination in the vertical direction. The most serious disadvantage of the Nernst lamp, which has to a large degree prohibited its more rapid introduction, is the trouble of retrimming or replacing the glowers, requiring as it does one experienced in the care and maintenance of this *special* lamp. For this reason the Nernst lamp is not extensively employed in residence lighting, its principal field of service being in large installations—in general office and department-store illumination.

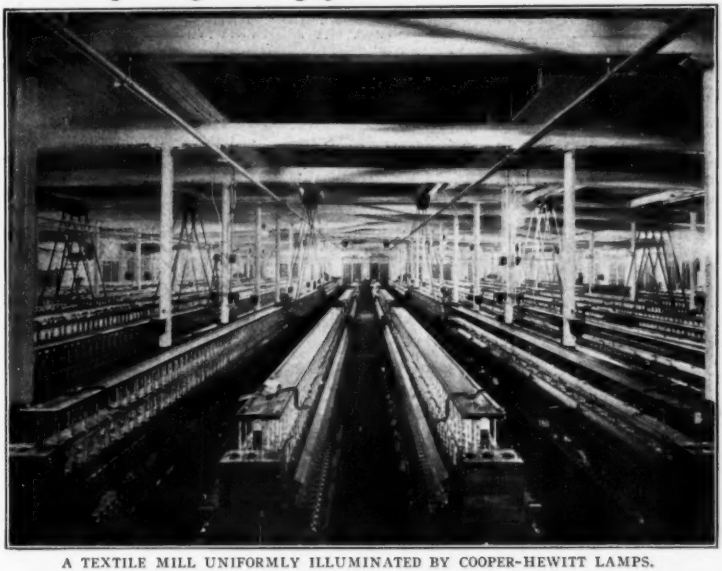
### Vapor Lamps.

Vapor lamps have a constantly growing field of usefulness and their gradual perfection for utilization in now restricted conditions of lighting service is promising. The best known types of vapor lamps are the Cooper-Hewitt and the Moore light. The former, which depends for its operation on the ionization of mercury sealed in an exhausted glass tube, is the invention of Dr. Peter Cooper



ILLUMINATION OF THE FALK FOUNDRY, MILWAUKEE, BY COOPER-HEWITT LAMPS.

Hewitt. One end of the tube is made in the form of an oval which is filled with mercury. Platinum terminals are sealed in each end of the tube for admitting electric current, the passage of which vaporizes the mercury into a stream of high conductivity. The conducting vapor is said to be "ionized" by the current, the two kinds of "ions" being termed, according to the terminal at which they are evolved, positive and negative ions. Luminosity of the lamp is produced by the incandescent particles in the vapor stream, the hypothesis being that the high temperature of the infinitesimal particles is due to the collision of the positive and negative ions travelling at enormously high speed. Although the temperature of the particles of matter in the tube is prodigiously high, the particles are so minute that the ultimate temperature of the lamp is reasonably low. Light is emitted in uniform intensity from every portion of the tubes, and there are no dazzling or bright moving spots.



A TEXTILE MILL UNIFORMLY ILLUMINATED BY COOPER-HEWITT LAMPS.

The chief field of usefulness of the mercury-vapor lamp is in a certain class of industrial lighting where the accurate determination of color value is not necessary. In recent years the Cooper-Hewitt lamp has been extensively adopted for the lighting of large machine shops and foundries; in business offices; in the press and composing

rooms of many large publishing houses; in railroad repair shops; in pier sheds and freight houses; in textile mills; in automobile garages and shops; in piano and organ factories, leather and paper mills, glass and rubber factories, copper and sugar refineries, hat factories, navy yards and wood-working plants.

### The Quartz Mercury Vapor Lamp.

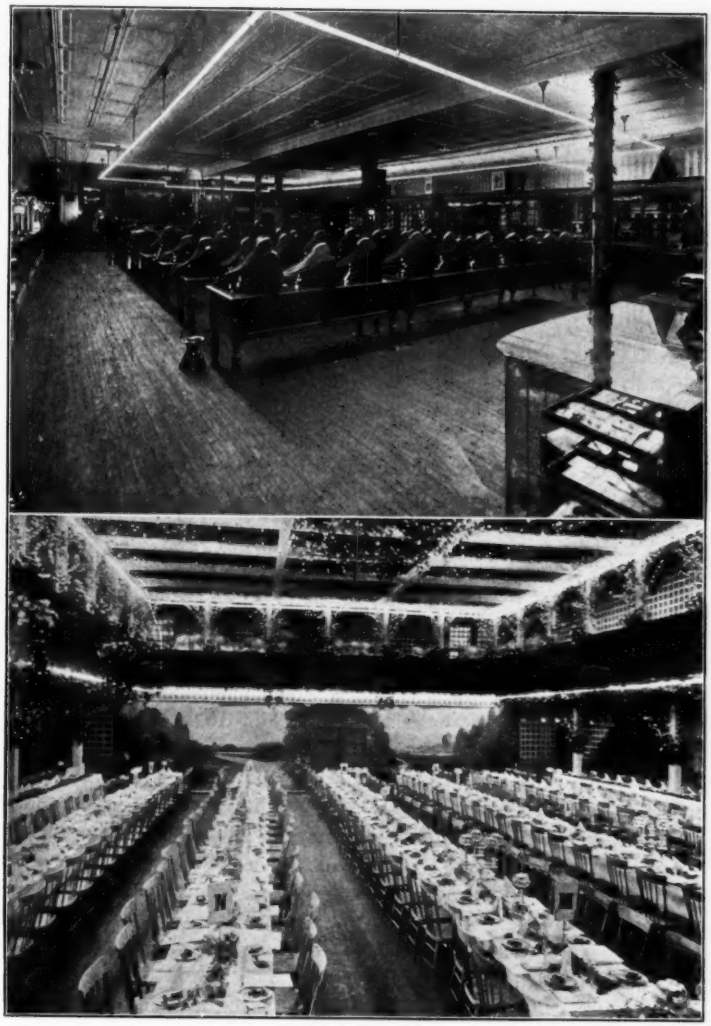
This is a specialized form of mercury-vapor lamp in which fused quartz is employed as a tube to withstand the very high temperatures at which the lamp operates. The vapor pressure at which the quartz lamp operates is about one atmosphere, the consumption of energy being about 0.25 watts per candle-power measured perpendicular to the axis of the tube. The arc in the quartz lamp is very much shorter than in the low-pressure mercury lamps, and as a result the dimensions of the tube required are small so that it is practicable to place it in a case and globe so as to resemble an arc lamp. Most of the quartz lamps at present are made for operation at voltages of 220 and 110 volts and are designed for currents of 2.5 to 4.1 amperes, according to size and voltage.

The quartz lamp is simply an intense mercury arc, mercury vapor being forced to high temperatures and powerful luminous intensity by concentration in a working tube of barely more than capillary dimensions. For instance, the luminous tube of one of the latest types of quartz lamps is about the size of an ordinary lead pencil and emits from 1,200 to 3,000 hefner-candles with an energy consumption of about one-quarter watt per candle. This consumption of energy is that of the voltage at the tube terminals which is about 85 for 100 to 130 volts of supply and 160 to 180 for double this voltage. Hence the efficiency based on the voltage of supply, including ballast, is not quite as good, being about 0.37 watt per candle, which, however, compares very favorably with that of the flaming arc.

Thus far the quartz lamp has only been used in Germany, chiefly for display purposes in very much the same manner in which flaming arcs were at first used in the United States. The properties of the lamp, however, are such that it is not unlikely that in time it will be seriously considered for general outdoor lighting.

### The Moore Light.

This invention of Dr. D. McFarlan Moore is similar in some respects to the mercury-vapor light in that it consists of a light source of larger area in the form of tubes of hollow glass varying from 40 to



THE MOORE LIGHT FOR INTERIOR ILLUMINATION.
Above, a clothing store lighted by the white Moore light. Below, banquet room for Taft dinner, Passaic, lighted by yellow Moore light.

over 200 feet in length, the tubes being exhausted of air and filled with a conducting vapor. The conducting medium is either nitrogen, which when the tube is electrified emits a yellow light and gives the highest efficiency; carbon dioxide, which emits a white light analagous to daylight; or plain air, which makes the color a pale pink tint.

The Moore vapor light possesses a number of advantageous features, chief of which are its *daylight color value* and its low energy consumption for a given illuminating effect. Tests have shown the Moore lamp to have but one-fifth the energy consumption of carbon incandescent lamps in 140-foot lengths. Operating with carbon-dioxide gas a 211-foot tube light gives an efficiency 1.5 times that of arc lamps of the enclosed alternating-current type. The specific energy consumption of the light is 2.84 watts per candle-power for tubes 40 feet long and 1.59 watts per candle-power for 220-foot tubes, operating on nitrogen gas. The average candle-power of the Moore Light is about 10.5 candle-power per foot of length. Under good conditions the life of the tube may be over 10,000 hours.

The Moore light is the nearest approach yet made to the much desired cold-light as exemplified in Nature by the firefly, and in the matter of diffusiveness, color, steadiness, efficiency, and safety is on a parity with a number of other electrical illuminants; and it is unaffected by heat, cold or moisture. The lamp is of low intrinsic brilliancy, emitting a soft, mellow light with no bright spots to blind the eye, hence is very suitable for illuminating auditoriums, theater and hotel lobbies, stores, etc.

Despite the above mentioned advantages, the Moore light possesses several obvious disadvantages which make against its utilization on an extensive commercial scale. Chief of these objections are its individuality, imperfect diffusion, fragility, and inefficiency as compared with the tungsten or flaming-arc lamps. Its color value is also not that of the continuous spectrum of natural light, but is the banded spectrum of gases. Its greatest disadvantage is that of not being a divisible light; a switch is thrown and all the light is turned on; with the Moore light we cannot have a little light here or there as we need it. The individuality of the light makes it necessary, in the character of lighting for which it is suited, to supplement it by some other system of lighting which has the feature of divisability. Again, the fragility of glass makes it impracticable to trust the lighting of an interior of much importance entirely to a long rectangle of glass tubing. Moreover, the breakage of the tube, especially in places hundreds of

thousands of miles distant from the factory in which the light is made, and which possesses the only workmen capable of doing delicate glass plumbing, would put the artificial lighting of a building, if done entirely with Moore tubes, out of service for days or weeks.

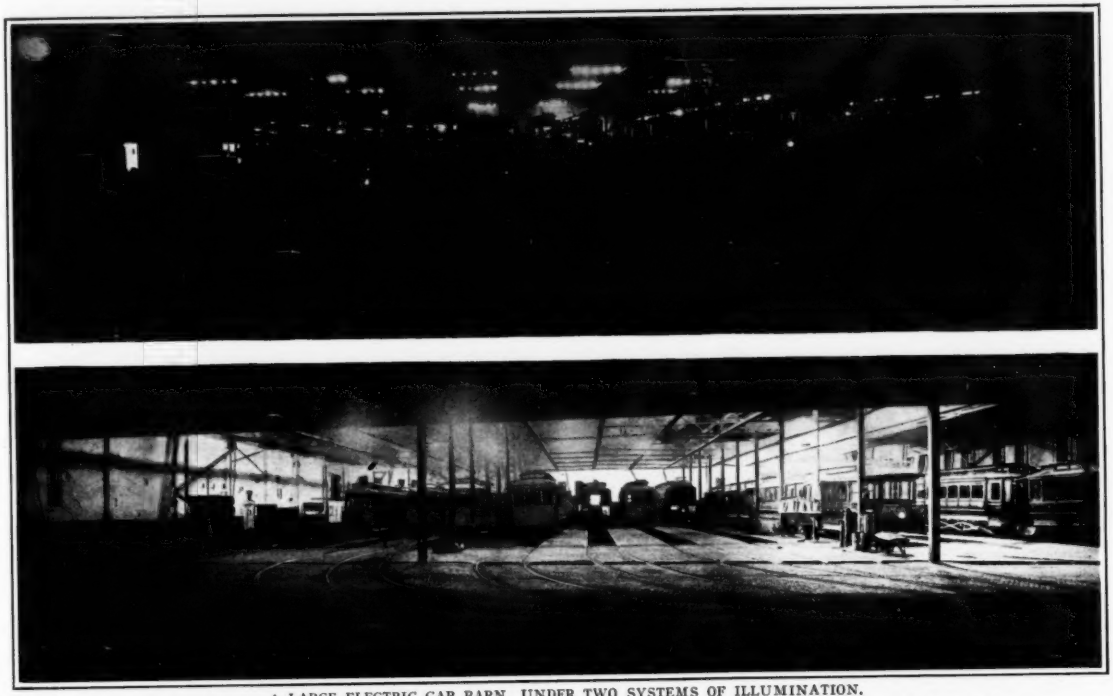
At the present time the Moore light is also an exclusively alternating-current lamp, and when it is used on alternating current of a commercial frequency it produces a marked flickering on objects moved quickly in the light. In cases where the objects must be handled with rapidity this is a serious practical disadvantage of the light. Another serious detriment of the lamp as a result of its indivisibility is its unsuitability for localized lighting. Where localized or concentrated lighting is desired rather than distributed lighting, the economical lighting of certain portions of the room instead of the uniform illumination of the entire room—a divisible illuminant must be used.

The history of the Moore light is, however, young, and the indefatigable efforts of the inventor in overcoming its shortcomings augurs well for its future as one of the foremost electrical illuminants.

### Some Points to Be Observed in Artificial Illumination.

The artificial illumination of the majority of rooms is accomplished by a combination of direct and indirect lighting; that is, some light comes directly from the lamps and from the reflectors over the lamps, and some is received from the walls by irregular or diffused reflection. If all of our light comes directly from the lamps and reflectors and none from the ceilings and walls by reflection, there will be many sources of light in a room, if sharp, annoying shadows are to be avoided. But in the case of a room with perfectly white walls, the amount of light received from the walls and ceilings by reflection is so large a percentage of the total that shadows are not so disagreeable. The first step in planning the illumination of any room is a careful consideration of this problem of shadows.

The second important step is the placing of the lamps with reference to the eye. A fundamental fact in artificial lighting of interiors is that the less exposed the lamps are to the direct view of persons in the room, the lower the actual illumination required because the exposed lamps exercise a well-known blending effect which causes surrounding objects to appear less distinctly visible than if the lamps were shaded. The judicious importance of these fundamental facts physiologically must, however, be often ignored when we consider illuminating efficiency aside from the effect on the eye and the overcoming of too sharp shadows.



A LARGE ELECTRIC CAR BARN, UNDER TWO SYSTEMS OF ILLUMINATION.
Above, the old method—carbon-filament lamps badly arranged. Below, modernized by Cooper-Hewitt illumination.

The word efficiency is applied so loosely in the technique of illuminating engineering that it is difficult to define it exactly, since so many elements enter into it. Thus the total amount of light emitted by the lamps in a room may be measured and the efficiency of illumination determined from this basis, or the total amount of light received on a plane 30 inches from the floor over the entire room may be measured and the percentage of the total light receivd on the plane may be called the efficiency of illumination. Neither of these measures of illuminating efficiency, however, makes allowance for the fact that the illumination may be received in such a way that it is very unsatisfactory to the occupants. For instance, a room may be very efficiently illuminated from a purely technical viewpoint by suspending lamps at frequent intervals on drop cords and enclosing the lamps in an efficient type of reflector (mirrored) which would cause all of the light to be thrown down onto the level of chairs and tables. Such a method of illumination would, however, be crude and unsatisfactory since a room so illuminated would be very fatiguing to the eyes, and from an esthetic viewpoint would be barbarous, for the reason that the contrasts would be too great, the upper part of the room being in semi-darkness while the lower part would be brilliantly lighted.

The proper and efficient lighting of interiors from both the technical and physiological viewpoints requires a certain satisfactory proportion between the light thrown upwards and that cast downwards. Practical illuminating engineers are agreed that in the majority of rooms, both large and small, comfortable and efficient results are obtained when from 25 to 35 per cent. of the total light produced is directed toward the ceilings and walls, the remaining 65 to 75 per cent. being directed downward for the direct use of the occupants. This is a general rule, subject to modification in cases where for special reasons more illumination is required on ceilings and walls. But this relative ratio is sufficient to define decorative effects on walls and ceilings properly while also maintaining the illumination on walls and ceilings at a low enough value to make the lower part of the room appear comfortably lighted to the persons reading or working therein.

In most instances where a room is poorly lighted it is due to the fact that more than 25 to 35 per cent. of the total light is thrown on the walls and ceilings. It is an indisputable fact that so many people have been led to believe by charlatans and ignorant inside wiremen that walls and ceilings must be highly illuminated to produce a good lighting effect that they continue to have their residences lighted so

that a larger proportion of light is cast on walls, etc., than is obtained from daylight illumination. Thus during the day the lower part of a room is almost invariably lighted to a higher intensity than the upper part, which condition is accepted as proper. Immediately artificial light comes on the conditions are reversed—the upper part of the room being illuminated more than the lower part, provided lamps are suspended high and proper provision is not made for directing the light downward.

These essentials lead to the question, how do modern lamps and reflectors conform to these requirements? As a general proposition it may be stated that all incandescent lamps if hung pendant and equipped with properly designed opal or prismatic reflectors which come down even with the tip of the lamp approximate these desiderata.

Until the past few years much of the illumination of interiors was designed by rule of thumb and haphazard methods of tyros styling themselves illuminating engineers, any arrangement of lights sanctioned by the owner of the building being considered good enough if the shibboleth of these tyros—"light, more light," was conformed to. Sad to say many of the crude and barbarous illuminating effects of the past (and unfortunately of the present also) were approved by some of the largest and most progressive of electric-lighting companies in the United States, any improperly designed lighting installation being winked at provided it brought in what the company considered sufficient revenue. Indeed, it was the boast of one of these large retailers of light that "it had forty illuminating engineers in its employ." The company, however, failed to state the qualifications their retinue of illuminating engineers possessed to deserve this most important appellation.

Happily the day is passing when illumination is based on empiricism and guesswork. The dawn of a new era in illumination is upon us, introduced by the newer types of high-efficiency lamps, and aided and furthered by the co-operation of the professional illuminating engineer, the progressive architect, and the modern electric-lighting corporation. Illuminating engineering is becoming more and more a fine art—an art in which it is everywhere recognized that technical training, experience, and esthetic sense are required.

# MAIL-HANDLING PLANT AT THE NEW PENNSYLVANIA TERMINAL.

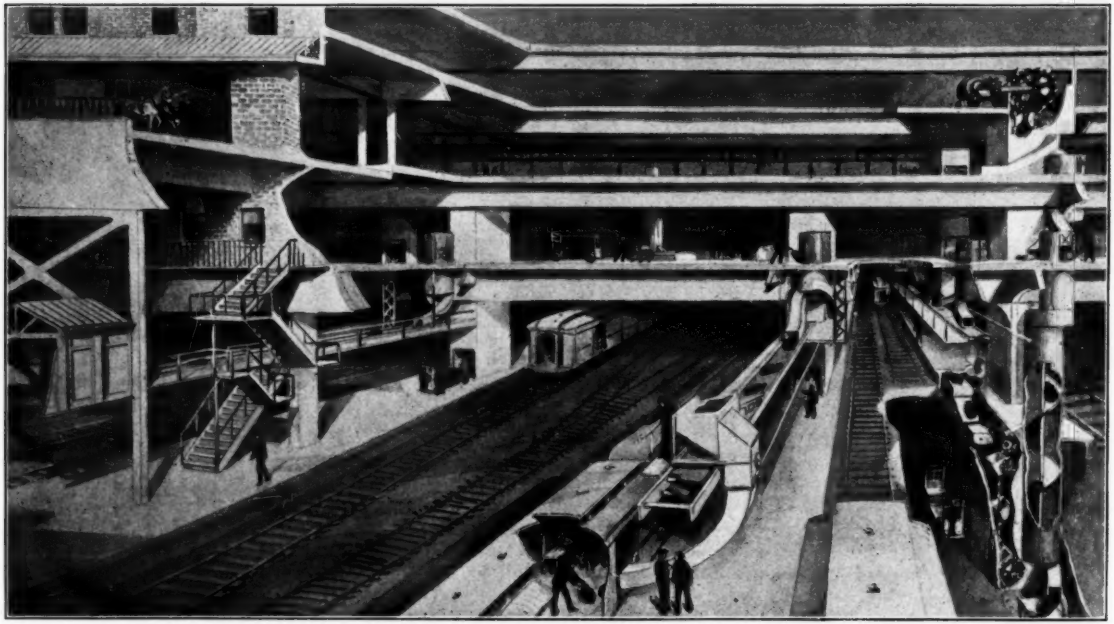
*By Joseph B. Baker.*

Mr. Baker condenses into concise form a practical description of a unique mechanical-transport installation, electric-motor operated, and embodying most interesting features of adaptation to difficult conditions of quantity, space, time, and material.—THE EDITORS.

ABOUT forty per cent of the total outgoing and incoming mail of New York City is handled over the lines of the Pennsylvania Railroad System. This mail, amounting in round figures to from 250 to 300 tons a day, is now concentrated at the New Pennsylvania Terminal, situated in the heart of Manhattan. In order to handle such a mass of mail an elaborate and unique mail-handling equipment was installed, involving the solution of a peculiar problem of mechanical engineering.

On November 27 last, the Pennsylvania Railroad in New York City, which had been operating partly via Hudson River ferries and partly by electric trains running through its Hudson-River and East-River tubes to its new terminal on Manhattan, discontinued this transition arrangement, and the vast steel and granite station, occupying the 800 by 434 foot area between Thirty-first and Thirty-third Streets and Seventh and Eighth Avenues, took up the service. On the same day a partially completed post-office building, occupying the site west of the station, was put into service to handle the mail. This building is being erected by the Government, and will be completed in 1912. It fronts on Eighth Avenue and extends from Thirty-first to Thirty-third Streets and about half way from Eighth to Ninth Avenues, and will be about 375 feet square. A private street runs along the west side of the building, connecting Thirty-first and Thirty-third Streets, and that side of the building is designed with an inner covered driveway 300 feet long and 32 feet wide and with an adjoining mailing platform 312 feet long and 35 feet wide for loading and unloading mail wagons.

Both the Pennsylvania Station and the new Government post office building span the tracks of the Pennsylvania Railroad, 50 feet below the street level. To provide for the railway mail service, the westerly end of the post-office building has been finished in a temporary manner, enclosing a space on the basement level nearly 360



A GENERAL PICTORIAL SECTION OF THE MAIL-HANDLING INSTALLATION AND EQUIPMENT IN OPERATION.

feet long by 170 feet wide, making provision for a large trucking plaza, offices for officials and clerks, and ample space for a complete railway-mail post-office equipment and a large force of postal employees. The mailing platform and driveway on the floor above the basement are also completely housed.

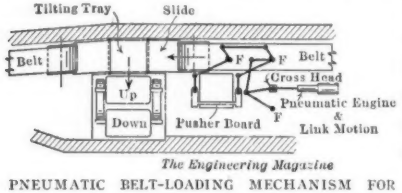
Provision had been made of the usual facilities for handling mail bags, substantially as found in all modern railroad stations. Four large plunger elevators provide connections between the mailing platforms and the basement and train-platform levels. Four train platforms and six tracks under the western end of the post-office building, offering room for a maximum of 26 mail cars at one time, have been set apart wholly or partly for the railway-mail train service. All four train platforms will handle mail departing from the station. The southerly platform is specially arranged for receiving the incoming train mail from the South and West. Aside from the heavy incoming and outgoing mails handled on these tracks, there are other mails, light but frequent, for despatch by trains on other tracks. These mails will be sent through spiral chutes or elevators down to a trucking subway 12 feet wide, extending eastward under the tracks nearly 1,000 feet, provided with transverse branches extending north and south, and connected with the various platforms by means of elevators. To facilitate the rapid transfer of mail from point to point on the various levels, from one level to another, and through the elaborate system of subways, a large number of electric motor trucks have been provided, each having a carrying capacity of 4,000 pounds, and the plunger elevators, between the different levels, have been designed with sufficient size and capacity to raise and lower these loaded trucks.

Such facilities, however, are not of themselves adequate to provide for the prompt handling and despatch of the enormous quantities of mail—250 to 300 tons, as already mentioned, comprising from 12,000 to 16,000 bags weighing from a few pounds to 300 pounds apiece—which daily depart from, and arrive at, this station. Since the trains are moving quickly in and out of a very restricted underground trackage network, this dense mass of mail must be handled with great celerity. Therefore a mechanism had to be devised which would be not only capable and reliable in operation but would embody such design as to go into a space cramped in the nature of things by the building structure itself—the latter being virtually a monumental traffic gateway straddling the underground railroad tracks. Further, this mechanism had to be free from all possibility of causing delay to train movements, or interfering with lines of sight on signals. In other words, a complex conveying machine for executing one of the

primary functions of a railroad station, mail handling, must be installed in waste underground space that had already been reduced to the lowest practicable amount by the railroad and building architects.

This problem, in which the Post Office Department was so vitally interested, was taken up by committees representing the railroad, the architects (Messrs. McKim, Mead & White), and the railway-mail department of the United States Post Office; and it was finally entrusted to Mr. J. E. Woodwell, of the firm of Marks & Woodwell, consulting engineers, New York City, who had already demonstrated special ability and resourcefulness in other Government work, notably in the Treasury Department.

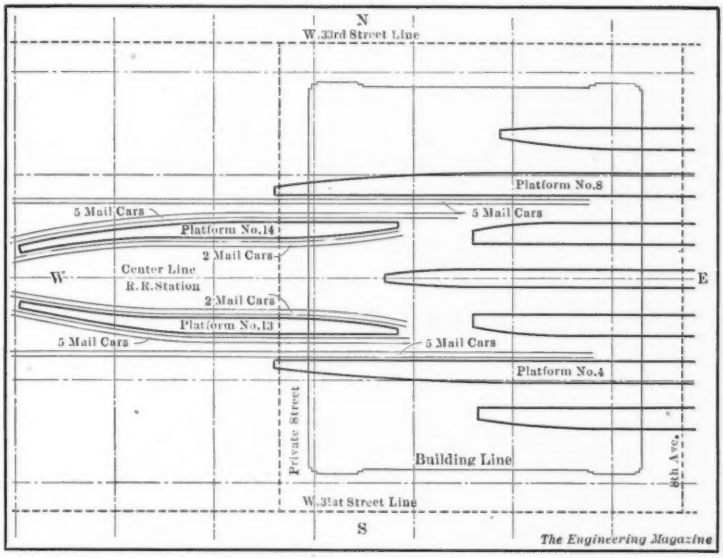
The unique engineering character of the mail-handling work, and the local restrictions, required a radical departure from conventional conveying-machinery design. In many parts of the system success or failure absolutely hinged upon apparently minor points. For example (and anticipating a little), in the mechanism designed to deliver incoming pouches to the underground conveyor-belts, at the loading stations, it was found necessary to give the pushers a peculiar motion —a quick start which gathers up the pouch smartly, and a slowing down at the end of the travel as the pouch is delivered to the belt. This motion was obtained by a toggle-linkage, as indicated in one of the illustrations.




PNEUMATIC BELT-LOADING MECHANISM FOR INCOMING MAIL.

Mr. Woodwell's solution of the task is already proved a success in the uninterrupted facility with which the mails have been handled from the start. In this system the intelligent application of electric power has increased the efficiency of mail handling and car utilization and saved much manual labor, notwithstanding the limited amount of underground space that was available for its installation. Moreover, the distribution of mail matter effected by the system is so complete that much of the sorting and re-handling formerly done on the trains *en route* is eliminated. Practically the entire cost of the installation was assumed by the railroad company and amounted to nearly $300,000.

Two classes of machinery are provided, one for handling the outgoing and one for handling the incoming mail. The mail to be dispatched on outgoing trains arrives at the station in wagons, which are unloaded at the mailing platform. Here the mail pouches are sorted, some of them being sent to the basement level through spiral

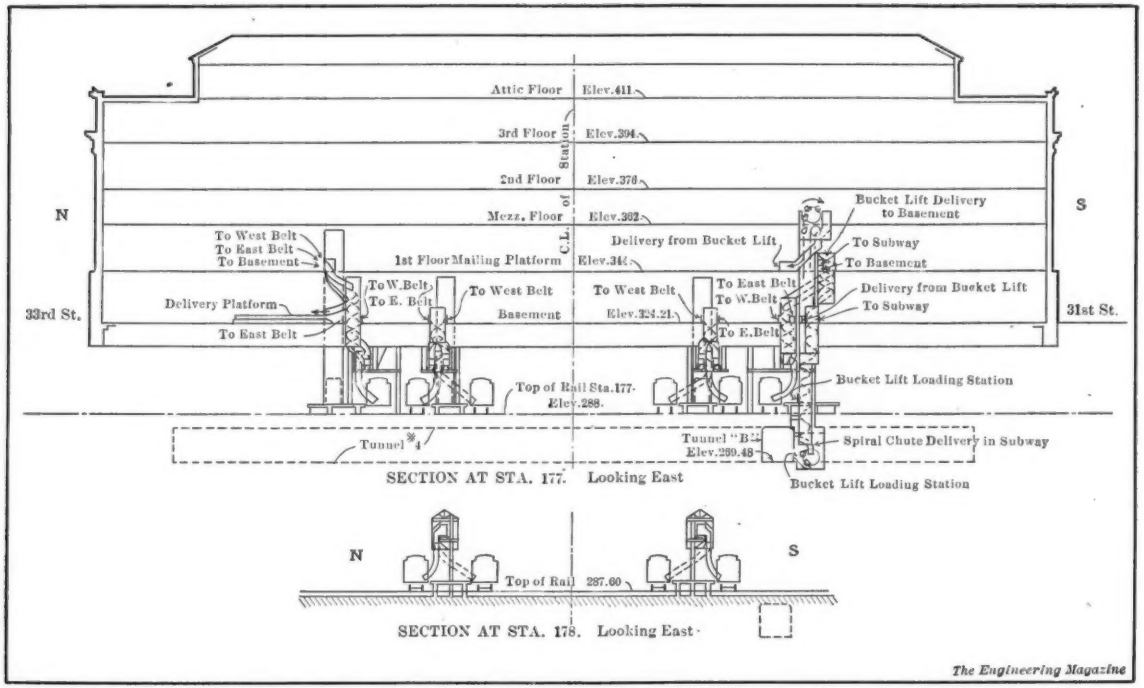



THE FOUR PLATFORMS AND SIX TRACKS DEVOTED TO POSTAL SERVICE, NEW PENNSYLVANIA RAILROAD STATION POST OFFICE.

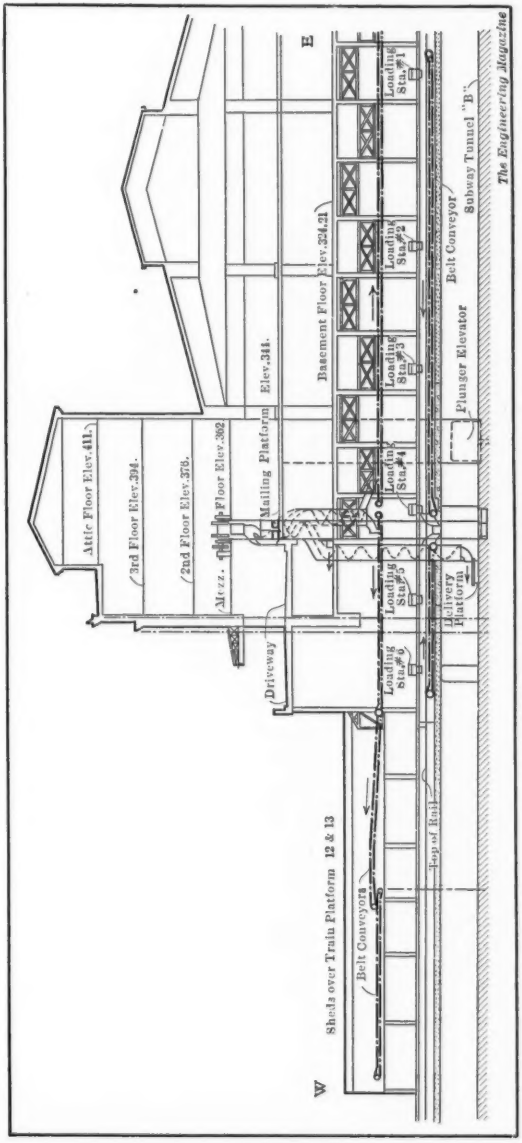
chutes, where they are opened and the contents redistributed and finally repouched; and the reassembled pouches, together with the unopened pouches, are then fed into spiral chutes, which deliver them to conveyor-belts located at the track level above the mail cars.* The belts are provided with automatic trippers or unloading mechanisms, which may be set opposite the door of any of the cars of the mail train, thus automatically unloading and transferring the mail through vertical slides directly into any one of the mail cars for which the apparatus has been set. Two belt-conveyers are provided over each of the four mail-track platforms, one belt extending east and one west of the connecting spiral chutes, which are constructed with separate compartments, one for each belt. By this means, two mail cars at each of the four track platforms may be loaded simultaneously.

The speed of the apparatus may be estimated from watching the loading of one of the heavy Western mail trains which carries the early morning newspapers and steamer mail, together with an enor-

* There are no pneumatic tubes for mail as yet installed in the new post-office structure at the Pennsylvania Station; but it is the intention of the Post Office Department to have a connection made between the "Times Square" postal station and the new post-office structure as soon as practicable. This branch line will establish connection with the pneumatic tube service of the city, which covers, with few exceptions, all postal districts south of 125th street.



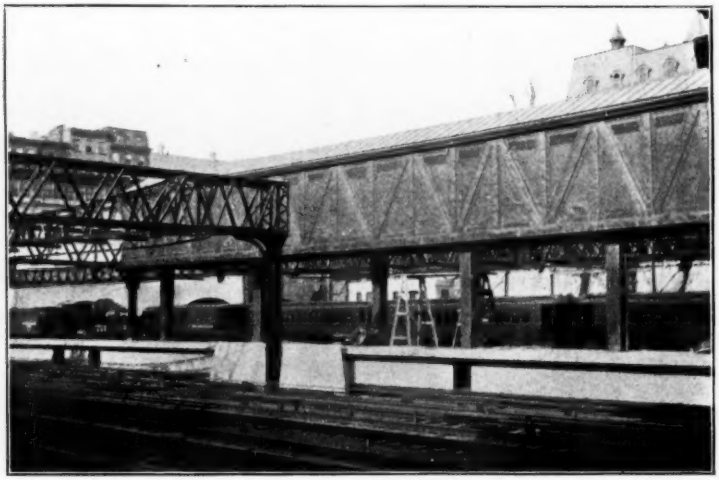

KEY TO ARRANGEMENT OF MAIL-HANDLING MACHINERY, NEW PENNSYLVANIA RAILROAD STATION POST OFFICE.




SECTION AT STA. 1+005, LOOKING NORTH.

mous quantity of first-class mail matter to Western points, amounting in all to over 50 tons, comprising 1,200 to 1,500 mail pouches. Much of this mail is resorted and segregated for the different cars and despatched from the station in less than three hours, over 25 tons being handled during the last hour, and the bags being frequently unloaded into the cars at the continuous high rate of one every second. From the spiral-chute entrances the bags descend through the winding convolutions, and continuing their journey along the rapidly moving belts, finally emerge at the door of the car.

almost noiselessly, the entire journey occupying about 30 seconds. To handel the incoming mails, openings are provided in the train platform into which pouches are thrown from the arriving cars. The mail is then transferred from these receiving hoppers or "loading stations" by means of belts located below the platform floor. A complex mechanism operated by compressed air is designed to feed the pouches on to the belt at suitable intervals, so that the pouches may arrive at the end of the belt at the proper time to be mechanically transferred to the buckets of a bucket elevator, by means of which the bags are elevated to the basement and mail-platform levels of the building. The belts and the bucket elevator are all operated by a single electric motor.

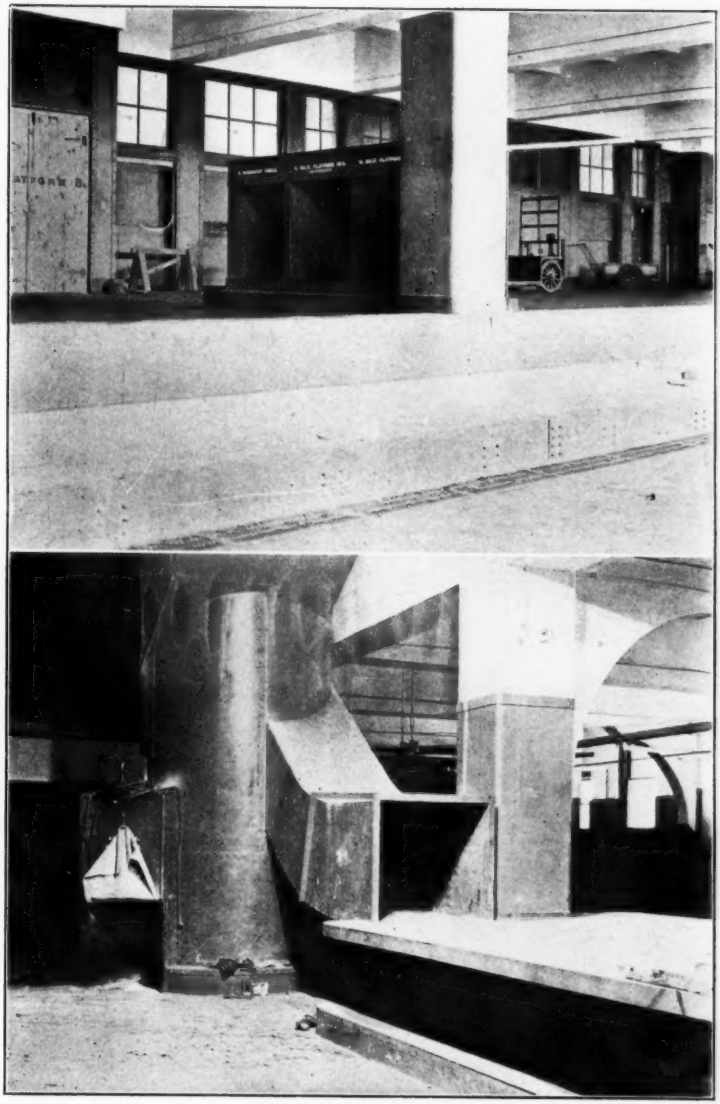


LOOKING EAST FROM TRACK LEVEL, SHOWING NORTH OVERHEAD CONVEYOR COMPLETE.

MACHINERY FOR OUTGOING MAIL.

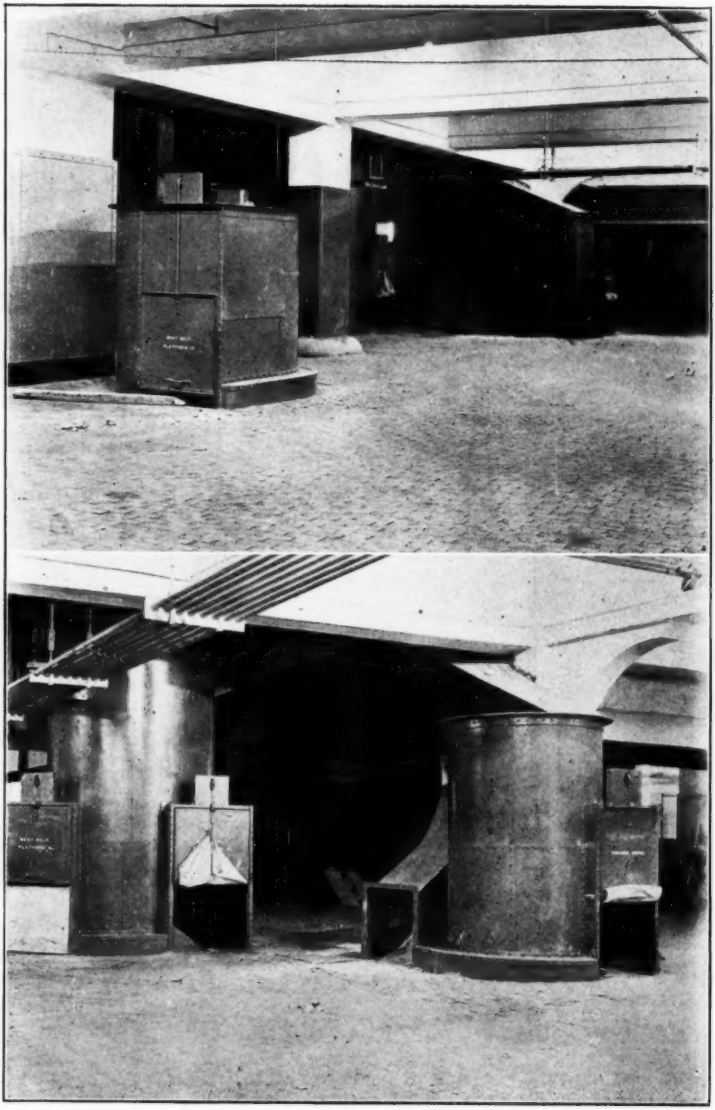
STRUCTURAL FEATURES.—In the post-office building, the supports for all overhead belt conveyers, driving motors, etc., are hung on the overhead framing of the building. There are two sheds for housing the belt-conveyers as they extend west of the building. These sheds are supported on single lines of eccentrically loaded columns, using the cantilever construction to permit the longitudinal travel of belt trippers or unloading devices.

SPIRAL CHUTES.—In the design of the spiral chutes certain complications had to be met, due to space limitations and to the relations of the working areas in the post-office (for the receipt and handling



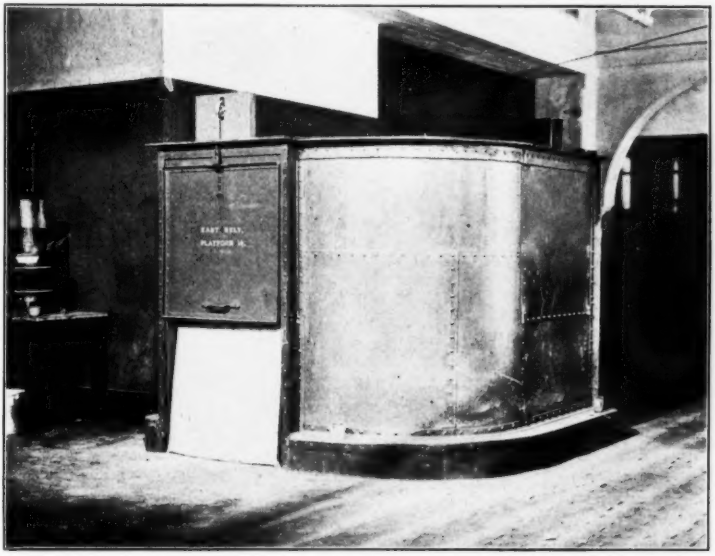
THE TRIPLE SPIRAL CHUTE.

The upper view shows the entrance, at north end of mailing floor. The lower shows the delivery table in basement, and inlet to east belt, platform 4.



BASEMENT CHUTES (AT LEFT OF THE UPPER VIEW) TO EAST AND WEST BELTS ON SOUTH ISLAND PLATFORM. AT THE RIGHT, THE QUADRUPLE CHUTE.
The lower picture gives a nearer view of the quadruple chute, showing three inlets and one delivery.

of the mails) to the platforms assigned to the railway-mail service. It was impracticable to make the spiral chutes vertical for the entire length, and it was therefore necessary to make numerous offsets of straight and curved slides. The vertical length of the chutes was also restricted by lack of head room and by structural conditions, and the inlet and delivery points of the chutes were fixed not only in height, but in arrangement and precise location. Space limitations also necessitated the grouping of the spiral compartments into double and triple chutes, and the arrangement of a single chute compartment for simultaneous operation at two different levels without interference. Moreover, it was impossible to make a symmetrical arrangement of the entrances to the triple and quadruple chutes, all four entrances of the quadruple chutes being placed on two sides and all three entrances of the triple chutes being placed on one side of the chute housing.

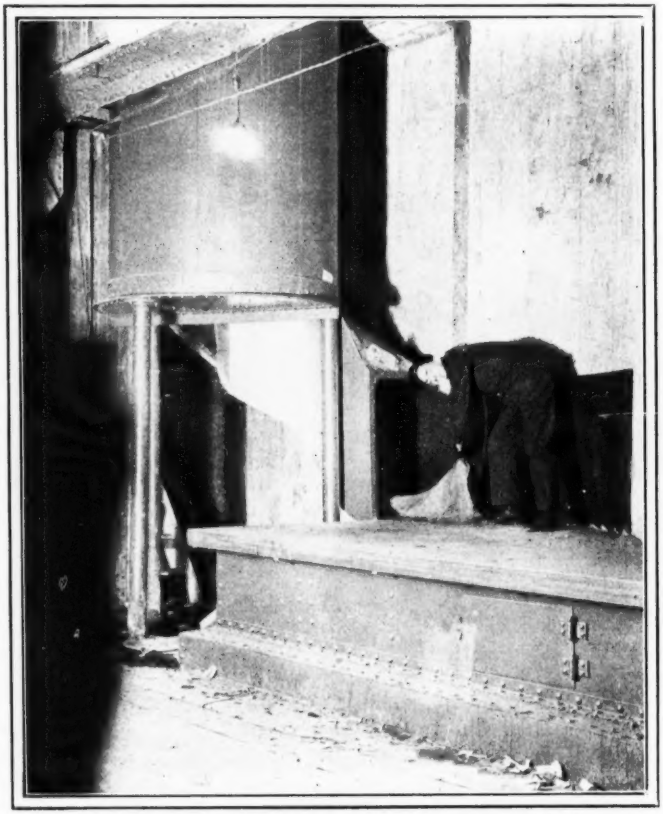


ENTRANCE TO CHUTE IN BASEMENT, SHOWING COUNTERBALANCED DOOR AND CANVAS WIND-CURTAIN.

The fixed conditions made it necessary to vary the pitch of the spiral slides at different points in the same chute, and to depend in some cases for positive action upon acquired momentum of the mail pouches, developed in points of the chute in which it was possible to use a more favorable pitch. In other cases the latitude in design was so small that the critical angle at which a mail bag will slide on a

polished metal plate is exceeded by only two or three degrees. It was also necessary in some instances to resort to reverse curves and to change of direction of motion of the bag by baffle plates. The problem was further complicated by the wide variation of loads, ranging from that of the small and practically empty canvas mail pouch to a full bag of periodicals weighing as much as 300 pounds. The spiral curves are so designed that the speed and certainty of delivery of bags of the two extremes in weight and size is regulated or controlled by centrifugal action. It has been found by trial that a single letter and a 300-pound bag are delivered through the chutes in approximately the same time.

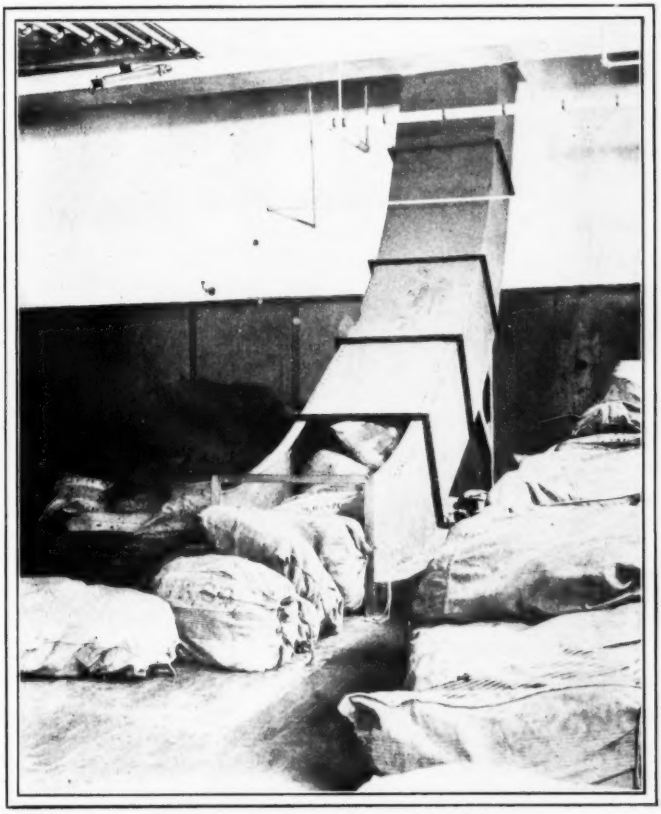
In addition to the spiral chutes a number of other direct chutes



DELIVERY TABLE AND SINGLE SPIRAL CHUTE IN TUNNEL B.

are installed, and these are constructed with curves of parabolic form, securing a maximum speed of descent but delivering the bags at the bottom at a minimum velocity.

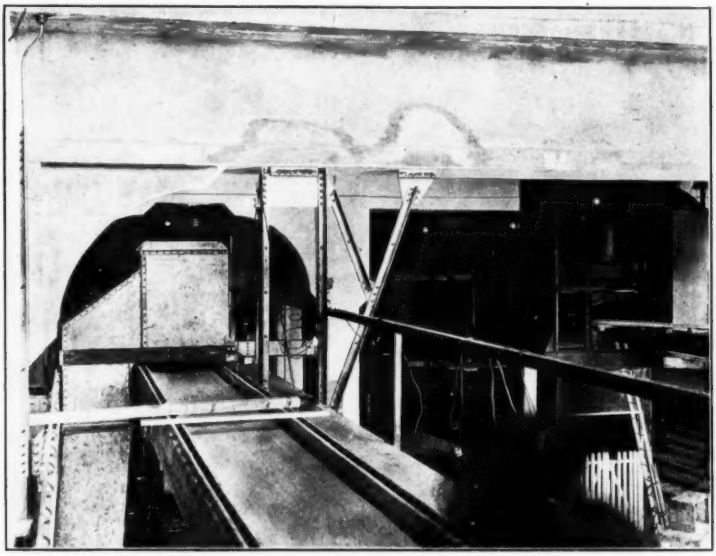
BELT-CONVEYERS.—The space limitations necessitated an entirely new design of conveyor-belt tripper, or unloader, for delivering the bags directly in at the door of the mail cars, through an adjustable spout. The tripper is equipped with self-propelling gearing, clutches, and control levers and pedals, including a rail-clamping or locking device to insure stability during the operation of the tripper. It travels on three rails, and is mounted on trucks with a three-point suspension to compensate for inequalities in track alignment. Two of the platforms are curved, necessitating the installation of two conveyor



NEWSPAPER MAIL SLIDE IN OPERATION.

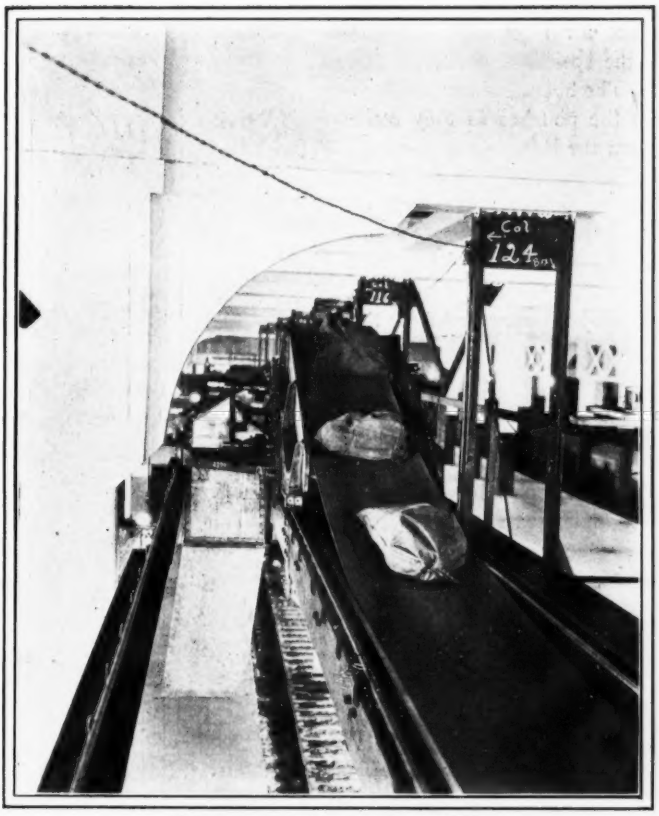
belts in series, with a special transferring device which was developed as an adjunct to two of the trippers.

To obviate the dripping of oil from the bearings of the overhead belt-conveyer rollers, it was necessary to use ball-bearings packed with grease and fitted with grease retainers. The application of ball bearings to conveyer rollers is not new, but it is believed that this installation presents the first application of the radial type designed with provision for expansion and contraction of steel shafts. The rollers and ball bearings are readily demountable, interchangeable, and adjustable, to secure the alignment of the belts. The rollers are constructed of light steel tubing. The material of the belts is the highest grade of five-ply heavy canvas of long-fiber Sea-Island cotton, impregnated with rubber and covered with rubber on both sides. The belts are made with half-round moulded edges, and contain almost half a mile of this rubber belting.



OVERHEAD BELT CONVEYOR AND BOTTOM OF ONE SPIRAL CHUTE.

MOTORS AND CONTROLLERS.—The motors are direct-current 650-volt machines and are connected with feeders from two different sources of current supply, viz., the third-rail system of the Terminal, and directly from the main bus bars of the local sub-station. The motors and controllers are designed for both armature and field control, in order to secure a wide range in speed variation. Drum-type




CONVEYOR BELT AND MOVABLE TRIPPER.

controllers are used, fitted with automatic overload and no-voltage release, push buttons being located at several stations along the gangways of the overhead belt conveyers to enable the motor to be stopped conveniently by the operator. The motor drive is a combination of silent-chain and spur-gear drive.

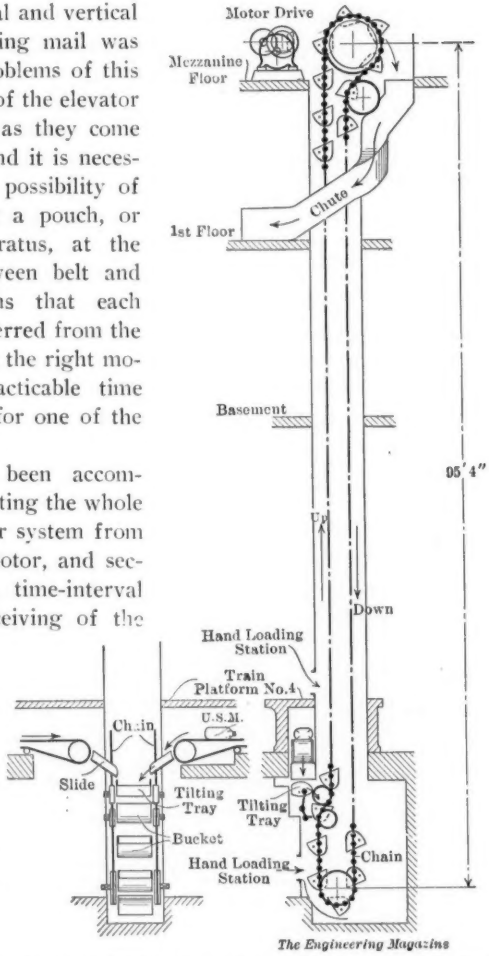
### Machinery for Handling Incoming Mail.

Belts.—The conveyer belts installed under the platform are similar in constructional details to the overhead belt conveyers.

"Loading stations," are provided at frequent intervals, having hopper openings in the floor into which the arriving pouches are thrown, to be received on the moving belt. The belts must operate in conjunction with the bucket elevator, and the design of this

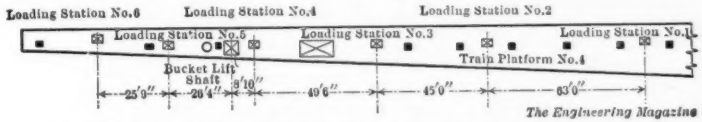
co-ordinated horizontal and vertical equipment for incoming mail was one of the special problems of this system. The buckets of the elevator pick up the pouches as they come to it from the belt, and it is necessary to eliminate all possibility of crushing or injuring a pouch, or deranging the apparatus, at the transfer point between belt and elevator. This means that each pouch must be transferred from the belt to the elevator at the right moment (within a practicable time margin both ways) for one of the buckets to receive it.

This object has been accomplished, first by operating the whole conveyor and elevator system from a common electric motor, and second, by applying a time-interval operation to the receiving of the pouches on the belt itself. When a pouch is thrown into the opening of a loading station it lands not on the belt directly but on a shelf above the belt. The pouch is pushed off this intermediate receptacle automatically, at the right moment, and falls on to the belt. The time of this deposit on the carrier is controlled by the movement of the distant bucket elevator, through the medium of compressed air in piping connecting with differential piston mechanism operating back and forth; the rising buckets, as they approach the delivery point of the belt, by operating a compressed-air valve




SIDE ELEVATION AND PLAN. CO-ORDINATED BELT CONVEYOR AND MECHANISM FOR HANDLING INCOMING MAIL.

included in this piping, cause the pouch to drop on to the belt at a determined instant. An interlocking mechanism prevents conflict of delivery of pouches from the two parts of the conveyer: When one belt is in operation the other is out of operation.



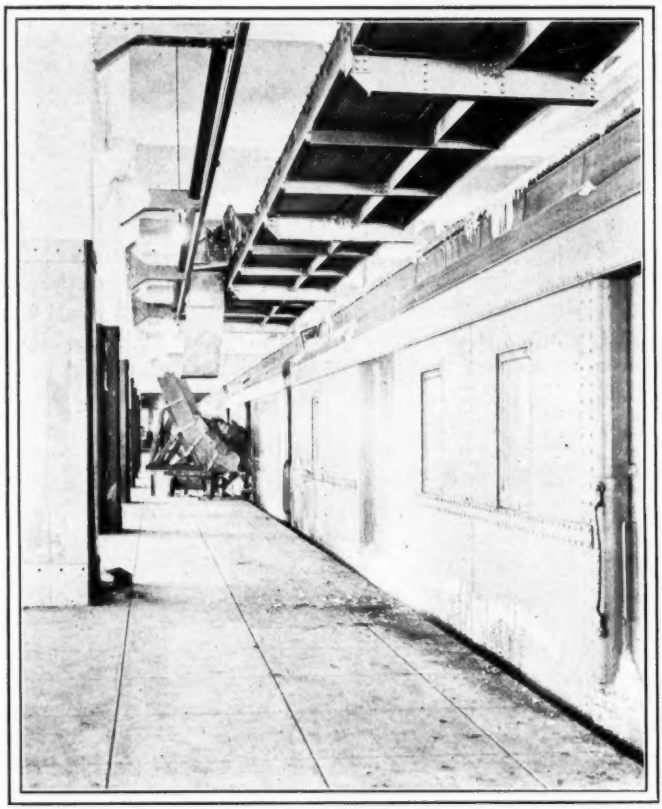

LAYOUT OF APPARATUS FOR HANDLING INCOMING MAIL, PLATFORM 4.

BUCKET LIFT.—The bucket lift is of special design in almost every particular. Some idea of its size may be gained from the fact that the buckets and the endless driving chains, together with the driving mechanism, weigh more than 20 tons, the highest grade of steel being employed in its construction. This elevator will handle 1,200 mail pouches an hour.

The driving chains are of short pitch, reducing the angular variations in velocity which obtain in the operation of the more conventional forms of bucket-lift driving chains, and securing a uniformity of motion approaching that of a belt drive. This end is also furthered by the design of special sprockets with double-staggered teeth. The chains have muitlple drop-forged nickel-steel links with solid bronze bushings, giving unusually large bearing surfaces on hollow pins of large diameter constructed of nickel steel, equipped with an internal system of lubrication, and so designed that lubrication may be regulated and maintained during continuous operation. The buckets are of pressed steel—thin, high-grade steel being used to reduce weight—and are fitted with re-enforcing end castings of steel, to which the chain pins are firmly secured. The buckets are so shaped that the bottom surface forms a slide of proper curvature to insure the positive delivery of the bags at the top of the lift.

Restrictions of space at the foot of the bucket lift necessitated the placing of the entire driving mechanism and slack-chain take-up at the top of the lift, in the mezzanine story of the post-office building. To reduce vibration and to secure proper alignment of parts, the entire overhead structure, motor and driving mechanism is supported on a massive base casting weighing several tons and filled with concrete, the whole resting on a sound-deadening pad of block cork.

To provide for the elevation and adjustment of the main bucket-lift shaft and driving sprockets necessitated a special design of driving mechanism, employing a propeller shaft with bevel gears mounted on



OVERHEAD CONVEYOR BELT IN OPERATION, WITH DELIVERY SLIDE SET AT A MAIL-CAR DOOR.

a radial yoke to secure permanent alignment between the stationary and the adjustable shafts, somewhat similar to the rear-axle propeller-shaft drive of an automobile. The bearings of the head shaft slide in curve guides, and are raised or lowered in parallelism by jack screws geared together for joint operation. The motor drive of the bucket lift includes a combination of spur and bevel gears, reducing the speed of the 650-volt, 50 horse-power motor from 150 to 4 revolutions per minute for the head shaft and main driving sprockets. The lubrication of shafts of low speed is secured by compression grease cups, and of shafts and bearings of higher speed by a complete system of forced-feed lubrication piped separately to each bearing.

# MODERN MACHINE SHOPS AND INDUSTRIAL PLANTS.

*By Charles Day.*

**This article concludes Mr. Day's unique and authoritative analytical treatment of the planning and building of industrial plants, which began in our issue of September, 1909. The entire series, enlarged, revised and adapted to book form, is just issuing from the press in a 300-page illustrated volume entitled "Industrial Plants; Their Arrangement and Construction.—THE EDITORS.**

THE plants of the Wagner Electric Manufacturing Company and the Orenstein-Arthur Koppel Company, previously described, are composed of a series of independent shops that adjoin and communicate with an erection shop. As has been previously stated, this type of layout has been adopted quite frequently for certain lines of work. The plant which we are now about to consider is of another well defined type, characterized by the condition that all the floor space needed is enclosed under a single roof. This procedure is made possible through the adoption of the saw-tooth roof, which eliminates the frequent necessity of providing areaways between separate buildings when roof lighting is not available. Of course the saw-tooth type of construction, when it is adopted in the manner that is now under consideration, necessitates the use of a ground floor only.

The plant of the Cincinnati Bickford Tool Company, shown in perspective in Figure 8, has been selected from a number of plants of the type in question as the combination of a number of different kinds of structures makes it a particularly good illustration of the manner in which definite industrial requirements were satisfied and future growth provided for.

The siding for the receipt and shipment of materials is shown in the foreground of Figure 1. The raw-materials and storage department is at present located in the rear of buildings "E" and "M-1," the front of the property being paralleled by the main line of the Baltimore and Ohio Railroad, which does not show in the illustration, Figure 8. Building "E" was designed primarily to accommodate the largest machine-tool equipment operated by this company and the erection of radial drill presses, but a section of it is used for the storage of heavy castings, so allowing for their transportation by means of the overhead traveling cranes installed

in this building. The section of the saw-tooth building designated "M-1" is occupied by the machine department except for the space allotted to raw material. The section of this building indicated as "M-2" was designed primarily to accommodate the department for the erection of upright drill presses and the smallest size of radial drill presses, but certain machine tools are also located in this area.

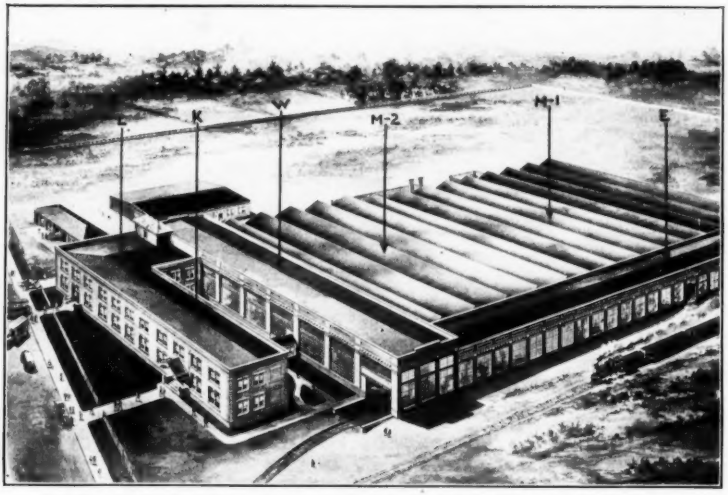



FIG. 8. PLANT OF THE CINCINNATI BICKFORD TOOL COMPANY, OAKLEY, OHIO.

Building "W" is used for the storage of finished product, an overhead traveling crane being provided for the handling of the upright and radial drill presses to the crating department located in this building, and finally for loading them on to the cars that enter the plant on the siding shown clearly in Figure 8. Department "M-2" is equipped with cranes operating in a direction perpendicular to building "W." so that the machines that are assembled in this department can be transferred to the warehouse with a minimum of handling. The construction of that part of the building that accommodates department "M-1"—namely, the machine shop—differs from section "M-2" only in that the headroom is 14 feet under the trusses whereas in the latter case it is 18 feet, the greater dimension being necessary in order to accommodate the erection work that has been referred to previously. Building "K" is a two-story office, and building "L" which adjoins the office and the warehouse accommo-

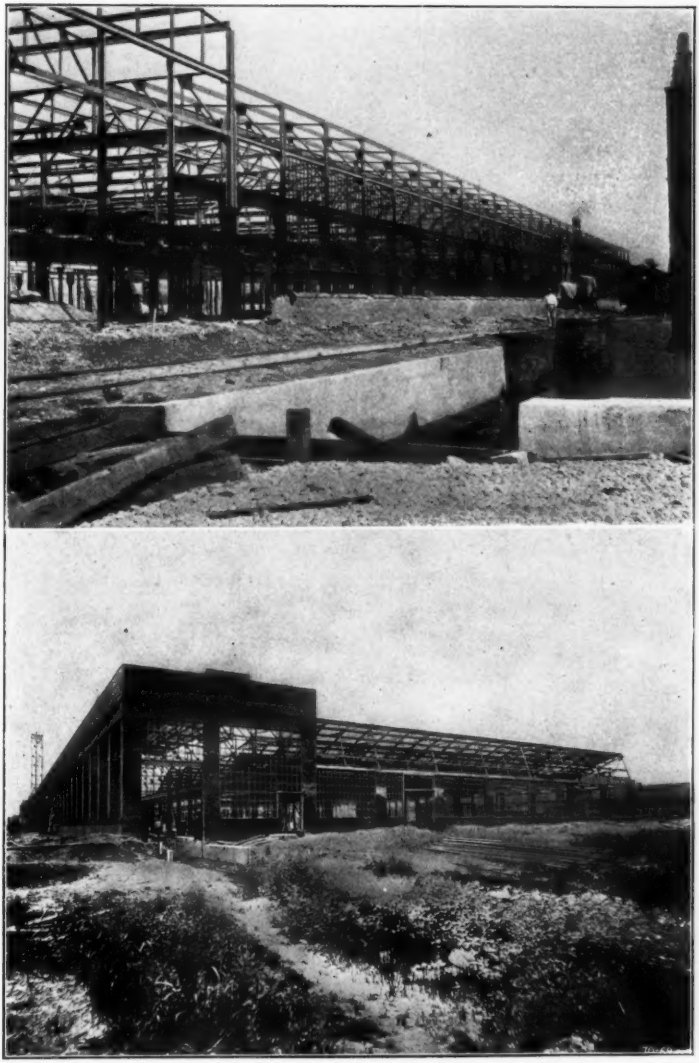


FIG. 9, 10. NEW PLANT OF THE CINCINNATI BICKFORD TOOL COMPANY, TAKEN DURING CONSTRUCTION.

The upper view shows in the foreground the steel frame for the erection and warehouse departments. The lower shows the erection and machine departments.

dates the pattern shop on the second floor and a service department for the employees on the first floor. The second floor of the office building, which is used by the drafting department, has direct communication with the pattern shop.

Figure 9 is a photograph of the plant during construction, showing the structural steel work of the end of building "W" and the side of building "E." Figure 10 is a photograph taken from the rear of the property looking into the saw-teeth of department "M-1" and showing the end of the erection department to the left. Figure 11 is an interior view of the machine and erecting departments.

The buildings shown to the left of the main plant (Figure 8) were constructed with a view to moving or taking them down when the time arrives for extending the plant in a direction perpendicular to the erection shop. The first extension, however, will be made in a direction perpendicular to the warehouse by adding to departments "E" and "M-1."

When the character of the work to be performed in a metal-working plant is such as to make it desirable to use single-story buildings the least amount of real estate is required if the type of layout is adopted that has just been exemplified. It is evident that the Cincinnati Bickford Tool Company will be able to utilize for shop purposes nearly all the property they have acquired if the growth of their business necessitates it.

Metal frames have been used throughout all the manufacturing buildings, both in the side walls and in the saw teeth. The plant is sprinkled throughout and the most approved appliances have been installed in connection with sanitation, etc A hot-water system of heating has been installed and the entire plant is driven electrically, the steam for the heating and the electric current for light and power being furnished by the central power station which serves the colony of machine-tool builders whose plants have been erected at Oakley, Ohio

In order to appreciate fully the advantages of the layout that has just been described, it is necessary to have not only a detail knowledge of the business in question but of the series of alternate arrangements or layouts for the new plant which were prepared prior to and resulted in the one herein illustrated The plant of the Cincinnati Milling Machine Company, adjoining the one just described, differs from it only in so far as the requirements of one business necessitate a somewhat different solution from the other.

A very large percentage of industrial plants handle a product that is characterized by its small bulk and the light weight of its

FIG. 11. INTERIOR OF CINCINNATI-BICKFORD MACHINE AND ERECTING DEPARTMENTS.

individual units. It was pointed out in a previous chapter that such requirements are, as a rule, satisfactorily cared for through housing the work in multiple-story buildings, which in one sense may be considered standard in their principal features, as they are suitable for many different businesses coming within the broad class in question. Therefore, insofar as the buildings proper are concerned, the question of layout is not a governing one, it being largely a matter of providing the requisite area. Of course the arrangement of departments and the grouping of equipment is a very vital matter to the business that occupies a building of this character, but for the moment we will not consider this phase of the subject. From this standpoint the principal matters of interest relate to features that make for the desirability of the building in question, irrespective of its occupancy. These are principally the ones of fire-prevention through non-combustible styles of construction, good natural lighting through the provision of a maximum window area, reduction of maintenance charges through the utilization of materials that will undergo the minimum depreciation, the provision of the most approved sanitary arrangements, and means for the prompt exit of all employees in the event of fire, explosion, or other catastrophes.

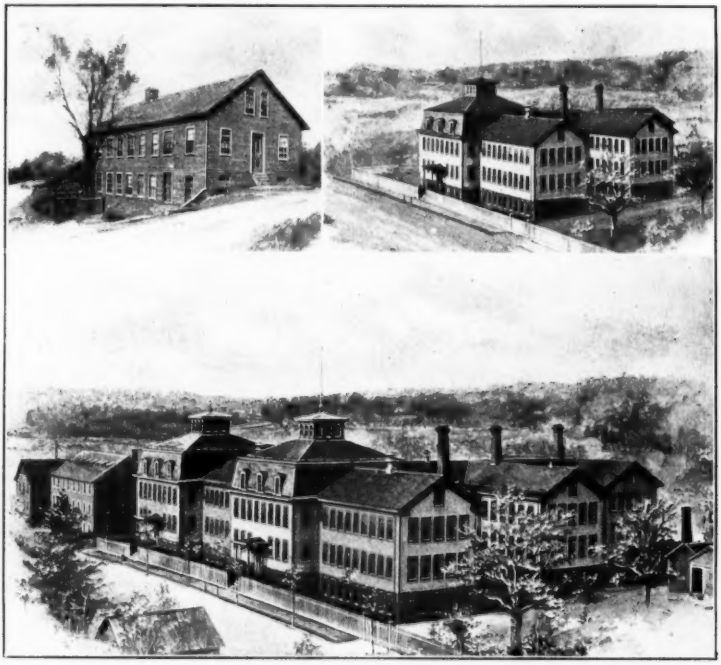


FIG. 12. STAGES IN THE EVOLUTION OF THE MANUFACTURING PLANT OF THE AMERICAN OPTICAL COMPANY, 1839-1872-1882.

These requirements have been satisfied with varying degrees of thoroughness by those who have recently constructed multiple-story manufacturing buildings, one of the best illustrations being the new plant just completed by the American Optical Company of Southbridge, Massachusetts, for the manufacture of spectacles and eyeglass lenses. This building incorporates all the features which the American Optical Company have found to be desirable from an economic standpoint after having given this subject their closest attention for many years. It represents the most recent attainment resulting from a gradual evolution that had its beginning in a small frame building constructed in 1839. Industrial manufacturing companies rarely consider the subject of their buildings with anything like the thoroughness that has always been the case in this instance, and as the procedure adopted at each important stage in the development was thoroughly tried out, the conclusions that have been reached are particularly significant. On this account I will recite briefly the

principal considerations that brought about the gradual change in a policy, which in the first instance sanctioned frame structures and at the present time dictates the use of wholly fireproof buildings possessing the characteristics about to be described. The principal product of the American Optical Company comprises spectacle and eyeglass frames, lenses and cases of all kinds and types, and in addition certain other allied lines.

The status of the construction of industrial buildings in the year 1839, coupled with the resources of those who commemnced at that time the business that has since become the American Optical Company, left but one course of procedure insofar as the plant was concerned; namely, the erection of an inexpensive frame structure. The business grew gradually in the beginning and prior to 1872 extensions were made at the original site. It then became necessary to enlarge the plant still further, and in order to provide for the future a new location was purchased and the buildings constructed that are shown in Figure 12, dated 1872. These buildings were all of frame construction throughout, but superior in many respects to the earlier buildings. Between 1872 and 1882, the plant was extended until it had reached the proportions shown by the third picture in Figure 12.

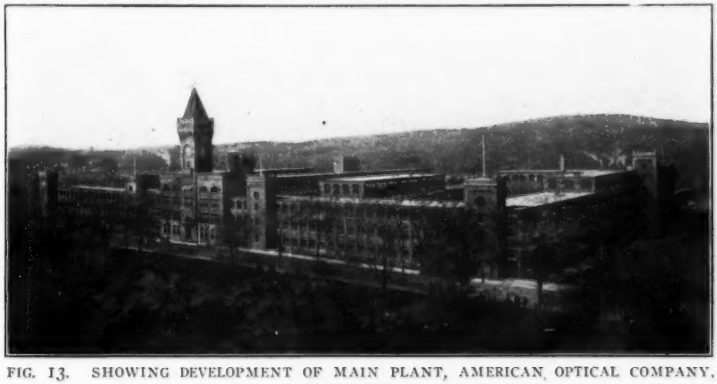


FIG. 13. SHOWING DEVELOPMENT OF MAIN PLANT, AMERICAN OPTICAL COMPANY, SOUTHBRIDGE, MASS.

Throughout the decade immediately prior to 1882 the business grew with very great rapidity, so that the value of the raw materials, finished parts, finished product, special machinery, and tools and fixtures housed in the plant, had reached a very considerable figure from the standpoint of invested capital alone; and when appraised as a factor in the perpetuation of the business, its value was, of course, much greater. A realization of this condition emphasized

the necessity of making all reasonable provisions for the prevention or isolation of fires, and definite steps were immediately taken toward this end. One of these consisted in the removal of all of the hipped roofs with their slate coverings and their replacement by flat roofs with felt and slag coverings, so eliminating the hazardous attics which formerly existed.

These buildings were also modified in numerous respects in order to render them more adaptable to the requirements of the business which the company was constantly defining with greater accuracy. It was not, however, until 1899 that the first building with brick walls was constructed. The decision to adopt this type, known generally as mill construction, was based upon the resulting reduction in fire risk and maintenance expense and the fact that the problems introduced by greater floor loads than had formerly been imposed could be very satisfactorily solved. After one of the old frame buildings was torn down and was replaced by a larger one of mill construction and brick walls, the advantages of the new structure were so apparent that it was decided to replace all the frame buildings as rapidly as possible. In this connection it is particularly interesting to note that it was not possible to keep abreast of the times through modifying from time to time the existing buildings, no matter how radical these modifications might be. The result could be accomplished only through destruction of the old and the building of entirely new structures.

Each building of the mill-construction type that was erected marked an advance in many particulars over those previously erected. For example, in the earlier types the heavy girders were built up by bolting together a number of timbers of the requisite depth but of such a width that in the aggregate they gave the required cross-section. The spaces between these timbers presented a very considerable fire risk, so that solid beams were substituted. The need of providing the best possible natural lighting, owing to the character of work performed, resulted in the adoption of larger windows in the side walls, accomplished through making the pilasters narrower and carrying the windows as close to the ceiling as was permitted through the use of a brick arch carried over the window head. The single flooring of the earlier types was soon replaced by double flooring, or superseded by it when new buildings were put up. Many of these early features of construction cannot be found in the present plant for reasons that have already been given.

As this work was progressing the plant was constantly approaching the appearance illustrated by Figure 13, this entire plant having

FIG. 14. VIEW BETWEEN THE BUILDINGS, SHOWING DIFFERENCE IN WINDOW CONSTRUCTION.

been constructed in eleven years, as has also a plant, located but a short distance from the main building, where all the lens work is done.

Before the plant illustrated by Figure 13 was completed the company adopted brick and steel construction in place of brick and timber. By so doing a greater window area was secured through making the pilasters narrower than before (this being made possible because the brick walls in this case are curtain walls and not bearing walls) and by carrying the windows up to within an inch of the ceilings, accomplished through the very ingenious adaptation of a Z-bar lintel, one leg of which carries the brick wall and the other the flooring, which consists in a 4-inch underplank, 1-inch lining, and maple wearing surface. These buildings incorporate the most approved practice in regard to fire towers and full equipment for the combatting of fires. Figures 15 and 16 illustrate the old and new types of window construction.

During 1900 it became necessary to make separate provision for the lens work, which had outgrown the accommodations available at the main plant and further required a special type of building for its efficient performance. The building that was constructed for this purpose is not included among the illustrations but is referred

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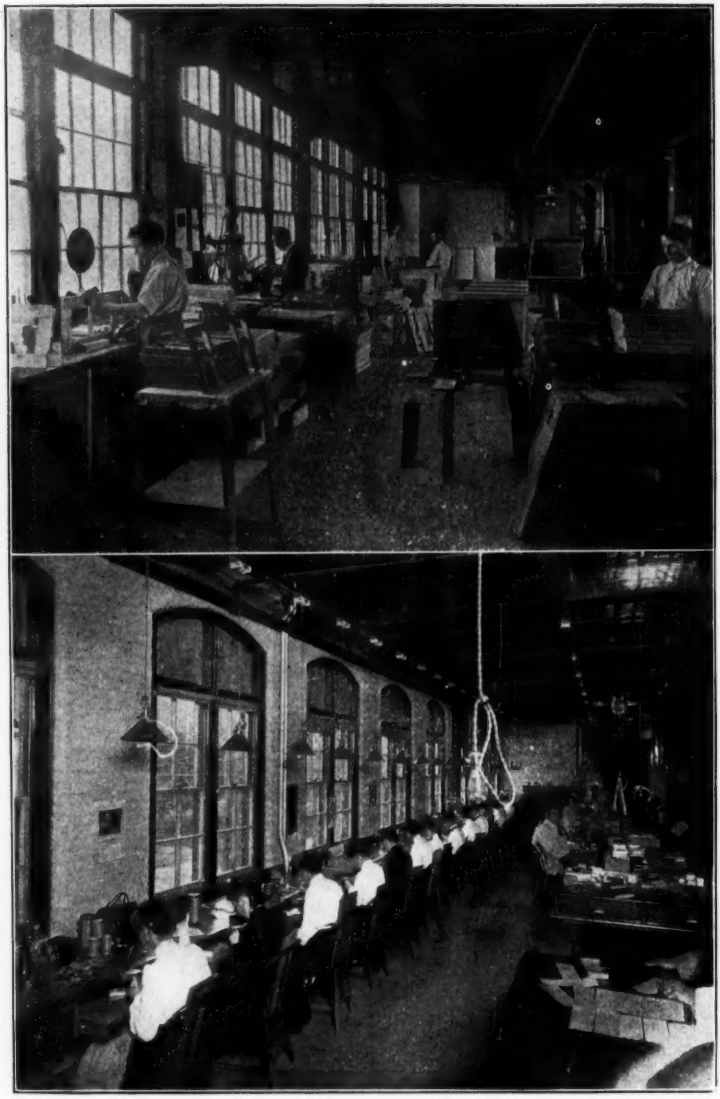

FIG. 15, 16. SHOWING NEW AND OLD TYPES OF WALL AND WINDOW CONSTRUCTION.

to as it marks a departure from the previous practice to the extent that a concrete floor was used.

The building most recently constructed (1910) is the one illustrated in Figure 17, being the new lens-finishing plant which was referred to previously as being one of the best illustrations of modern multiple-story building construction. Figure 18 is a near view of

FIG. 17. NEW LENS FACTORY, SHOWING WINDOW CONSTRUCTION.

one of the side walls and shows the stair and elevator towers which also accommodate the toilets. Figure 19 is a photograph of the fourth floor before any painting was done, and shows the floor construction, the extent to which natural lighting has been secured through side windows, and the location of the hot-water pipes for heating. Figure 20 is a photograph of one of the departments that was taken before it was fully equipped and gives a good idea of the appearance of the interior after the painting is completed.

A tunnel 10 feet wide, 8 feet high and about 1,500 feet long extends from the power plant to the main plant, passing directly under the lens building just described. As the main plant is separated from this lens factory by a stream, the passageway gradually emerges from the ground and spans the stream, entering the main plant above grade. The principal object of this tunnel is to carry water and heating pipes and light and power wiring. It is constructed of reinforced concrete, the design having been very efficiently worked out.

The adoption of reinforced-concrete construction throughout, metal window frames, a sprinkler system, and the absence of any adjoining fire risk, have resulted in the attainment of a minimum fire

FIG. 18. NEW LENS FACTORY, SHOWING WALL AND WINDOW CONSTRUCTION.

hazard, and the fact that the windows extend from within a few inches above the floor (a condition consistent with the manufacture of a light product) up to within a few inches of the ceiling, and from pilaster to pilaster, assures the best conditions for natural lighting. The problem of heating has been simplified by double-glazing all the windows. The entire floor areas are available for offices, manufacturing departments, etc., no limitations being imposed through

the presence of partitions, stairs, or other enclosures that would interfere with the most efficient disposition of the space. While utility was the motive that governed in the design of this building, yet I think it will be generally conceded that an exceedingly satisfactory

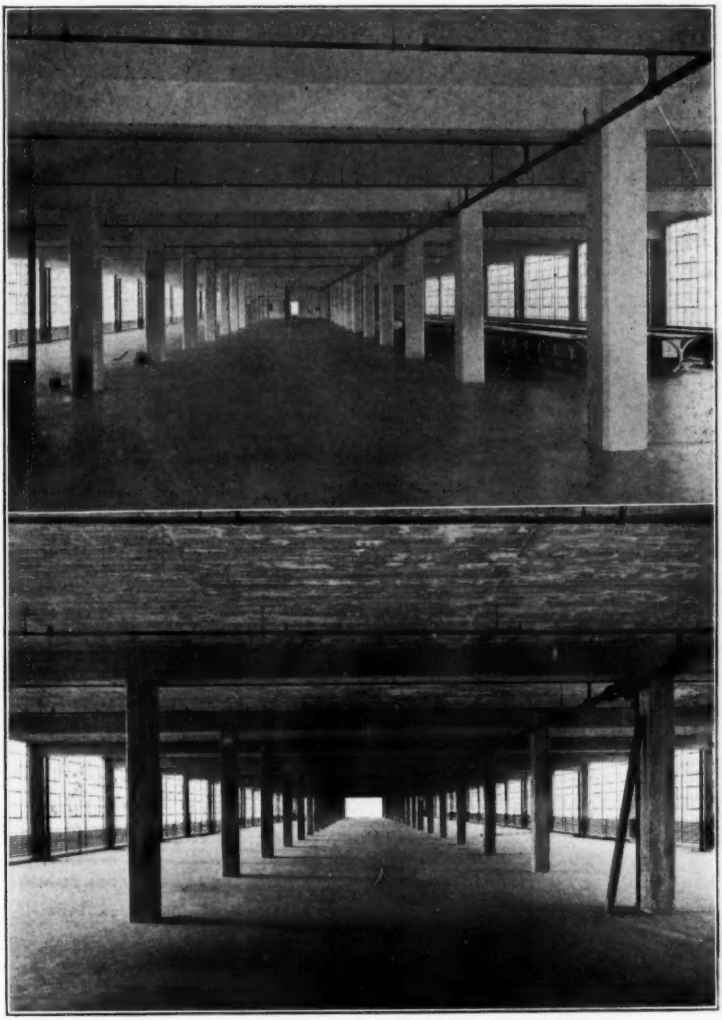

FIG. 19, 20. FOURTH FLOOR, BEFORE AND AFTER PAINTING.

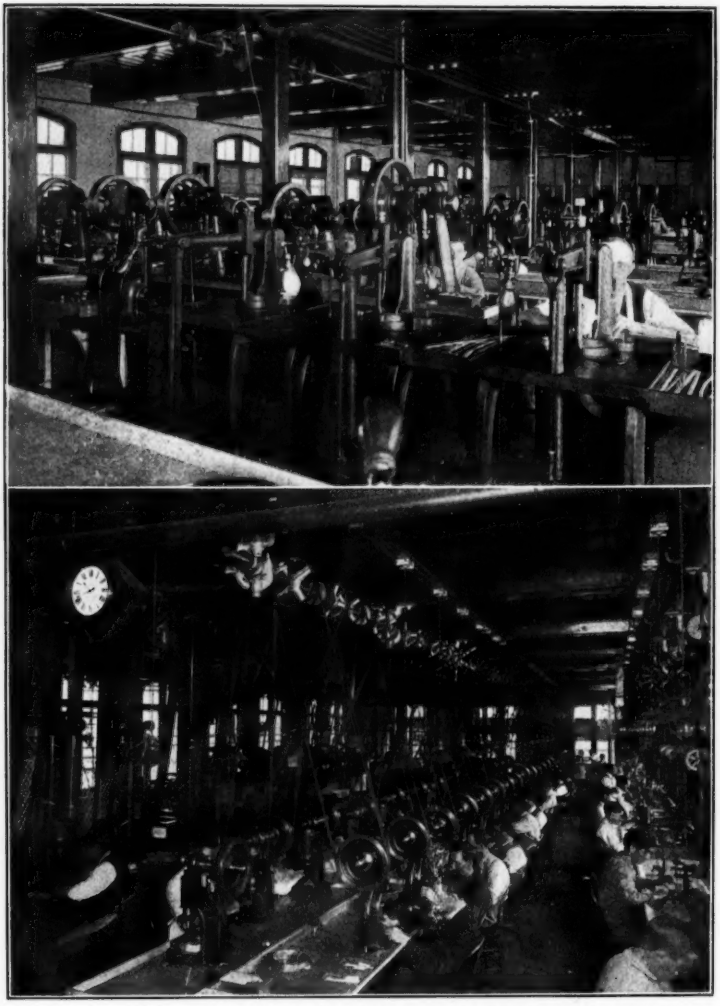

FIG. 21, 22. NEW AND OLD ARRANGEMENT OF PRESS ROOM, AMERICAN OPTICAL CO.

and pleasing appearance is presented by the exterior, the simplicity of the treatment being in thorough keeping with the uses for which the building is intended.

All the features that have been touched upon so far in connection with the plant of the American Optical Company are governed

FIG. 23. INTERIOR VIEW OF ONE OF MAIN OFFICE DEPARTMENTS, AMERICAN OPTICAL COMPANY.

only along very broad lines, by the special requirements of this particular manufacturing work. If the methods that have been worked out by the American Optical Company for their own buildings are efficient for their purpose, they are equally suitable for many other lines of light manufacturing work. Each manufacturer, however, must make provision which is wholly special in many particulars for the actual work that he intends to do. However, even in this regard there are certain matters, such as the provision for artificial illumination, method of driving the equipment, the manner of laying out work benches, etc., which present the same essential requirement, irrespective of the industry. Figures 21 and 22 show the old and present methods of driving certain equipment in the plant of the American Optical Company, and also exemplify the practices of laying out benches during the respective periods. It is not necessary to dwell upon the desirability of eliminating overhead line and countershafts for at this time these are generally appreciated. The layout of benches illustrated in Figure 22 is, however, a departure that is comparatively new and possesses many decided economic advantages. Better natural lighting is secured, a greater number of

operators can be properly accommodated within a given area, the product can be handed to and from the operators with greater facility, and by having all the operators face in one direction, a more strict attention to their work is automatically secured. Individual lights are provided for each operator. They are mounted upon suitable stands connected by a flexible cord and attachment to the circuit, which is in conduit and made fast to the backs of the benches. There are many other features in regard to the equipment of the plant that I would like to mention, but those just referred to serve as good illustrations as they are thoroughly characteristic. An interior view of one of the main office departments is shown in Figure 23.

While I have described very briefly the evolution that marks the gradual perfection of the buildings that from time to time have composed the plant of the American Optical Company, yet it must be apparent to the reader that this development could never have taken place were it not for the unceasing attention to all the problems involved and ability shown in their solution upon the part of the men at the head of this business. I feel especially indebted to them for making available the material that I have used, and wish to take this occasion to thank them for the co-operation that they accorded me.

# SYSTEMATIC FOUNDRY OPERATION AND FOUNDRY COSTS.

*By C. E. Knoeppel.*

## V. THE IMPORTANCE OF EFFICIENT DISPATCHING IN THE FOUNDRY.

**In the article inaugurating this series, published in October last, Mr. Knoeppel outlined the elements of the foundry problem. His second paper discussed thoroughly the very important question of depreciation as its comprehension applies especially to the profitable conduct of a foundry business. In December he took up the remaining elements to be recognized in foundry organization and accounting and defined the character and limits of each. His fourth instalment dealt with the problems of production and the systematic treatment of the conditions that affect the actual productivity of the workman and the foundry. He proceeds now to the dispatching of the work, thus making a practical application of the efficiency principle discussed by Harrington Emerson in this same issue.—THE EDITORS.**

PARADOXICAL as it may seem, many apparently unimportant things are found in the end to be vastly important. Under the heading "delays" in the previous paper, it was found that the waste of five hours of the twenty-four spent on the job in question, was due to causes most of which could have been eliminated. No one would accuse the management of this shop of deliberately forcing the five hours of waste time on the moulder who made the work. If not the result of deliberation, the waste must have resulted from carelessness, faulty conditions, or other reasons. It seems certain it could not have been considered of the utmost importance or steps would have been taken which would have resulted in the wasted hours *not appearing in the list.*

What then was the trouble? It can no doubt be said for this particular shop management that it was probably doing the best it could to run things economically, according to the generally accepted conception of what constitutes the best one can do; it was probably holding its own with other foundries in turning out castings of good quality in point of material and workmanship; it was no doubt ambitious to get castings made as quickly as possible; it probably felt a "fall down" as keenly as you or I would feel it; it no doubt possessed as good a technical knowledge of the foundry business as would be found in other shops. Yet in spite of all this, the illustration cited shows very forcibly that something must have been decidedly wrong—something that would justify a careful analysis as to underlying causes, with an outline of a more efficient procedure—the purpose of this paper.

Did you ever see a bird in its search for twigs, straw and the like? Hunting these things for fun? Hardly. It is simply planning ahead against the time when a warm, comfortable nest will be wanted for the little ones to come. It does not wait until they have arrived—the bird sees to it that the nest is ready before it will be needed and as a result we call it a wise bird.

Watch a sprinter. He does not depend altogether upon his speed to carry him over the course. His whole aim is centered on the *start*—the dash at the crack of pistol. Even to the long-distance runner the start is of moment—he thinks ahead. Would he run his head off at the beginning? Not if he knew the racing game as an expert knows it. His start would consider conserving his energies for the contest before him. He would even let others pass him, secure in the belief that the finish would take care of itself if the start was one that did not make too many inroads upon his vitality before he got his "second wind."

These illustrations point out a lesson worthy of attention, for they show conclusively the importance of the prepared state—*the value of the start.* Results, whether in life or in business, depend largely upon this start, but *industrial endeavor has suffered much from failing to give proper attention to a definite plan of procedure.*

This, then, is a cause of the trouble that we started to find. If the work had been made to submit to a definite plan of procedure, the start would have received its share of attention—as much attention as the work itself, if not more. Not only is this general neglect of the start largely to blame for troubles, but the spirit of things is usually impulsive rather than methodical. "Get the thing done" is the order, and the procedure becomes one of a rush, hustle, tear-things-to-pieces kind, in a mad effort to obey orders, regardless of whether or not these orders could have been obeyed to better advantage some other way.

Suppose, for instance, that a corporation decided to build a railroad from one city to another, and that without a survey or general plan, it commenced to lay tracks—strike a stream—have a bridge built and set—then continue laying track—run into a hill—cut a tunnel—lay more track, and finally build a depot at the end of the line. What kind of a policy would this be called? Yet this is the way that many foundries are operated. A foundry should be managed just as a wise corporation would build its railroad, by having a definite plan and the bridge building and setting, the tunneling, the erecting of a terminal, and the grading and track laying *all going on at once.*

To test the question I would ask those in positions of authority to try the following: In the first place size up the situation generally as regards work under way, orders ahead, etc., and after the noon hour, call in the shop foreman, the core-room foreman, the flask boss, the flask carpenter, the man in charge of the pattern storage, the labor boss, and the pattern-shop foreman. In a general way tell them that the purpose of the meeting is to line up the procedure for the next day and perhaps the day following, and that each one will be expected to outline his share of the work. Be prepared to list the procedure as it is outlined. Have before you a list of the moulders and begin by asking the shop foreman what he proposes giving each of his men on the list, for next day. Also inquire what they will start on after the work just mentioned has been made. Ask the foreman for his ideas as to the time the jobs mentioned will probably take. If two jobs are not sufficient for the day, get him to assign enough work to cover the man's time fully.

Now get your core-room foreman to advise you what cores he has made or is going to make for the next day's work. Ascertain if the pattern-storage man can tell you what patterns he has laid out or is going to lay out for the work on the following day, and then quietly ask the labor boss what rigging in the way of flasks, plates, etc., he is planning to bring in for the work to be made in the next few days. See if the flask boss can tell you what he is doing towards getting flasks ready for the next day's work, and then ask the flask carpenter what flasks he is working on or what he expects to work on to accommodate the new work coming in. Find out what patterns the pattern-shop foreman is getting ready for the shop. Other questions will suggest themselves as you go along, which you can put to those interested.

After each one has had an opportunity to outline his share of the procedure, dismiss the meeting and study carefully what you have before you. Also arrange on the following day to check up the shop operations to see how closely the outline of the preceding day is being lived up to by each one interested. Note the waits, delays, changes in plans, etc. If the results prove surprising both in the meeting and the procedure on the day following; if you find the "all pull together" spirit conspicuous by its absence; that the actual carrying out of the work comes as close to schedule as a train in a winter blizzard; if you find that the meeting which started with broad grins ends in bewilderment and confusion and that there was considerable guess-work about the whole thing, *it is safe to conclude that the value of the result depends upon the efficiency of the start.*

A train leaves New York at eight o'clock in the morning and is due in Buffalo at five o'clock in the afternoon, stopping at Albany, Utica, Syracuse and Rochester. From the time previous to its leaving New York until it arrives in Buffalo, the train is carefully watched, its leaving time at each point being wired ahead, orders being issued at each stop for the next lap of the journey. Does the engineer or conductor worry about the arrival in Buffalo? Hardly. Their chief concern is the trip from New York to Albany; Albany to Utica; Utica to Syracuse, to Rochester, to Buffalo. If engines are to be changed at Albany, the engine is ready when the train pulls in. If a slower train is ahead of the fast one, at a certain place, *known in advance*, it is side-tracked to allow the fast one to pass. In case a dining car is to be attached at Utica, it is a safe bet that the diner will be added to the train as soon as the stop is made. If the crew is supposed to change at Rochester, it will be found that the new crew is on hand and waiting for the train—something would happen if they were not. The train arrives in Buffalo on schedule time, according to a plan mapped out in New York before the train left, and lived up to all along the line—a smooth, harmonious working arrangement, known in railroad circles as "dispatching"—the theory of which is, *no train is ready until everything is or will be ready for the train.* Why not therefore apply the same theory to the foundry business and dispatch jobs in the same manner as a railroad dispatches its trains?

In order to get all that is possible out of the foundry, we must get away from the theory that making a piece of work depends altogether upon the moulder, for the moulder in the broadest sense *is only a medium*—the factor between (A), what he is given to work with, (B), the conditions under which he works, and the finished casting, from which we can readily understand why A and B should receive careful consideration in their relation to proper dispatching of work—more attention than is usually given them.

As to A—the articles a moulder is given to work with—they can be classified as follows:

1—Those subject to changes (equipment and rigging)
- Patterns
- Sweeps
- Flasks
- Loam plates
- Lifting plates or rings
- Spindles
- Arbors
- Cores

2—Those subject to little or no change.
- A—Facilities
  - Sand
    - Facing
    - Heap
    - Parting
  - Risers
  - Nails
  - Gaggers
  - Rods
  - Chaplets
  - Blacking or wash
  - Clamps
  - Wedges
  - Chains and rolling devices
- B—Tools
  - Rammers
  - Hammers
  - Shovels
  - Finishing tools
  - Torches and wicking
  - Hooks
  - Wood screws
  - Brushes and swabs

Concerning B—the conditions under which a moulder works—it is obvious that he can work efficiently only when he can use, to the best advantage, the items listed at A, so *it is distinctly up to the shop management* to see to it that the men are not held up because of faulty conditions. They must be made right. As an example of what I mean:—a moulder (now a shop foreman) had been hired, and, coming from another city, he started in the next morning. He was given a piece of work to make, and from 11 to 12 o'clock he was hunting up gaggers for his mould; not finding any, he looked up his foreman and advised him as to his fruitless search. The foreman asked the moulder if he thought he had any tucked away in one of his vest pockets, to which the moulder replied —"no and I didn't bring any in my grip either." After the noon hour, the moulder quit and the foreman was at a loss to understand why. The moulder was quick to see that he would be working at a disadvantage if the foreman evinced no greater concern than his remark indicated, and the foreman violated two of Mr. Emerson's twelve principles of efficiency—common sense and the fair deal—first in making the speech he did, and second in not seeing to it that the gaggers were quickly found and promptly supplied the moulder.

These conditions we may classify in a general way as follows:

1—Foundry orders—knowledge of and their following up.

2—Storage and handling of materials, supplies, etc.

3—Selection of patterns, sweeps and core boxes.

4—Repairing and altering the above.

5—Selection of flasks.
6—Repairing and altering the above.
7—Flask storage, piling, etc.
8—Removal of castings, gaggers, rods, etc., from the sand.
9—Tempering of moulding sand for use by moulders.
10—Mixing of facing sand.
11—Shop carrying arrangements with reference to the equipment and rigging listed at A1.
12—Supplying the moulders with facilities listed at A2A.
13—Furnishing the moulder with proper tools by list A2B.
14—Crane facilities.
15—Arrangements as regards the general shop labor.

Foundry dispatching is made up of three principal elements—
1—The parties concerned.
2—The planning.
3—Execution according to the plans

and if proper attention is given to them, faulty conditions will cease to exist, for their assumption is—*no job is ready until everything is OR WILL BE ready for the job.* The persons concerned are—

1—The foundry foreman
2—His assistant
3—The core-room foreman
4—The pattern-shop foreman
5—The man in charge of the pattern storage.
6—The man in charge of the flasks
7—The flask carpenter
8—The labor boss.

The element planning is made up of six principal considerations—

1—*What* is to be made } Selection
2—*Who* it is to be made by }
3—*Where* it is to be made —Location
4—*When* it is to be made —Commencement
5—*How* it is to be made } Procedure
6—*With what* it is to be made }

while *execution* is made up of—

1—Knowledge of the plans made
2—Preparations for carrying them out
3—Carrying out the plans as per schedule.

Now that the articles used have been classified, the general shop conditions outlined, and dispatching defined as regards elements and

considerations, the task of next importance is to harness the three together so as to make an efficient working arrangement. To this end we must give some consideration to that which is really our starting point—*the order* both as regards its *availability* and *the promise to ship*. Right here is where nearly every foundry experiences trouble—some occasionally, others nearly all the time—because not enough attention is given to the availability of the work and promises are made before all the facts are known.

What must be considered in order to pass upon the availability of a piece of work? An order must pass the following test:—

1—Are the patterns and core boxes as per order?

2—Are they ready for delivery into the foundry?

3—Is there a flask or flasks to accommodate the work?

4—If not will one have to be made, or can other flasks be altered to suit, and if so, what work will be necessary?

5—What will the job take in the way of rigging?

6—Is the rigging on hand ready for use or will it have to be made? If it will have to be made what will be necessary?

7—Will anything be necessary in the way of specials, as for instance rods, gaggers, clamps, etc.?

8—How long will it take to get the job prepared as above?

Until an order can pass this test, it should be classified as *not available* and everyone so advised and under *no consideration except that of the most extreme urgency should such a job be started.* A rule of this kind will work wonders in any foundry.

After the matter of availability has been passed upon, the next thing to consider is—the promise—a point about which a book could be written. A few years ago in this magazine, the author made the following statement, in a paper on—"Better Deliveries—More Satisfied Customers"—

> A promise composed of about one-quarter discretion in making and about three-quarters energy in fulfilling will go a longer way towards enabling the manufacturer to ship according to schedule, than anything else. By energy I do not mean the hustle and bustle, at the last minute, in an almost superhuman attempt to rush the work through the shop and onto the cars, in an effort to make good, but an energy that is in evidence from the time an order is received and the promise made, until the material is on the cars and finally at its destination.

Orders are either accompanied by a request to make shipment at a certain time or are marked "rush," "as soon as possible," "at once," or perhaps the making of the work is left altogether to the shop management. Promises are usually required in all instances, and if

not they should be made and recorded just the same as if they were required so that there will be some information on hand should the shop be asked a little later to furnish some idea as regards shipment. After promises have been made, it is not a difficult task to keep such track of them as will result in an excellent knowledge of anticipated delivery dates. One thing should be remembered, however—*promises should never be made before the availability of the work has been passed upon.* Such promises are never dependable and the time and energy in making them is usually wasted—as a great many know.

An efficient order arrangement that will give proper consideration to the two features (availability and the promise) must therefore be so arranged as

1—To admit of a quick and ready reference as regards the various items called for.

2—To show availability or non-availability, *at a glance.*

3—To show anticipated delivery dates.

4—To notify the pattern storage what is wanted in the way of patterns, sweeps and core boxes.

5—To enable pattern storage to promptly notify foundry as to the condition of the items called for.

6—To have the patterns, sweeps and core boxes laid out by the pattern storage in a space necessary to allow those who are responsible for the planning to get at them easily.

7—To show the reasons why the work is not available.

8—To have a provision for checking the work as the following items become ready—

A—patterns and core boxes; B—flasks; C—rigging.

It is evident from the above that we are now in possession of three valuable items of information—

1—We know what is *not* available and *why*

2—We know when work becomes available

3—We know when work is wanted or the promise date,

this knowledge serving as a valuable aid in keeping after the jobs not available and selecting what should be made—a condition of affairs much to be desired, as everyone conducting foundries can well appreciate. If every foundryman was in possession of the above information, what a saving there would be in time that is now wasted because the patterns are not ready, or cores are not made, or flasks are not in shape, or rigging is not in, and many other causes which result in loss of time that nets the company absolutely no return for the amount invested.

With our knowledge of what is available and what is to take pref-

erence, we can commence the task of getting the work under way according to the following general outline—

1—The work should be in charge of a committee comprising the foundry foreman, his assistant, the core-room foreman, the flask and labor bosses.

2—The work should be undertaken as early in the day as possible so as to allow ample time to get in readiness whatever may be needed to start the jobs off properly.

3—The work being made in the shop and the men engaged on it should be carefully sized up.

4—A means should be provided for listing the work as planned.

5—In selecting the work, the six considerations under the element *planning* should be brought into play.

6—If more than one job is selected for a man, attention should be given to the order in which they are to be made, as in this way it will be known what work to get ready first.

7—The core-room foreman should note carefully the selections so he may have the most important core boxes sent in first.

8—The flask boss should note what flasks will be necessary for the various jobs that are planned.

9—The labor boss should note what rigging will be necessary so that he can get at work as soon as the planning is over with.

10—A means should be provided for marking the patterns, with the names of the men who are to make them.

11—The pattern-storage man should set apart from the patterns available such as have been scheduled for making.

With the above consideration given to the planning, we can next consider the third element of dispatching—*execution*. As was previously pointed out, this is made up of three steps—knowledge of the plans made, the preparation for carrying them out, and carrying out the plans as per schedule.

KNOWLEDGE OF THE PLANS MADE—Any plan for betterment, in order to be productive of results, must take into consideration the importance of a general understanding of things. Several persons may be involved, and unless the relation of each to the whole scheme of things is clearly outlined, there is certainly going to be confusion, the same as there would be confusion on a railroad (or even worse, a serious wreck) if there existed any doubt as to a correct understanding of the orders that may have been issued. With this in mind, the idea of presenting the plans made to those interested, in some convenient form for reference purposes, is therefore self-suggestive. This should be done as soon after the work of planning as possible, in

order to give those concerned the schedule of work so that they will have plenty of time in which to give proper consideration to the next step—

PREPARATIONS FOR CARRYING OUT THE PLANS—An analysis of this will show that it divides into the following—

1—The patterns

2—The cores to be made

3—The flasks to be located, repaired, or changed

4—The rigging to be brought in and the necessary changes made.

5—Special features looked into; for instance, special gaggers, rods, clamps.

6—Changes in conditions to facilitate the particular work coming in.

7—The work at night.

PATTERNS—Small patterns should be brought into the foundry on the afternoon previous to making and placed in racks for the men. Large patterns should be brought in toward night and be arranged in some convenient place from which point they can be easily handled.

CORES—As soon as possible after the planning, the core-room foreman should see to it that the most important core boxes are sent in so that his force can begin on them without delay. As soon as he gets his schedule showing the planning in detail, he can have the rest of the boxes brought in and the cores made in the order in which they are scheduled to be used.

FLASKS—The man in charge of the flasks should ascertain what is necessary to take care of the work coming in. Flask parts that may have been previously made should be assembled; those needing chucking or changes in the barring should be promptly attended to, the necessary patterns to be taken from the pattern storage for this purpose. If repairs are needed they should be made at once.

RIGGING—Rigging in the way of plates, rings, arbors, etc., should be brought in and the necessary changes made so that they will be available when wanted. Only in very rare instances should a moulder have to wait until an arbor or a ring is looked up and brought into the shop.

SPECIAL FEATURES—If special gaggers, rods, or clamps will be needed they should be made on the day previous so as to be in readiness when wanted.

CONDITIONS—Changes in conditions should not be slighted. A job may take a special mix of sand; a pit may have to be dug; a large amount of heap sand may be needed; brick may be used, or something else possibly varying from the ordinary method of procedure

may have to be done, and the time to do it is certainly not when the moulder is at work.

NIGHT WORK—The man in charge of the night force should be informed as to his share of the work necessary to carry out the procedure as scheduled. Castings should be shaken out and taken to the cleaning floor; gaggers removed from the sand heap and placed on the back end of the floors; sand tempered and put in condition for use by the moulders in the morning, and the flasks not needed by the men taken from their floors. Pits should then be dug according to the sizes needed for the work to be made in them.

At any rate, a proper knowledge of the plans plus careful preparations will assist materially in getting everything in readiness. There is no excuse, except perhaps in the case of breakdown jobs, for work to be held up because something has been overlooked. Wise planning will see further than the day following—it will look two or even three days ahead, so that if a flask has to be made or rigging planned, the work can be begun a day previous to scheduling the jobs.

CARRYING OUT THE PLANS AS PER SCHEDULE—This is a subject of vast importance. Planning in itself may be careful and thorough; preparations to carry plans out may be up to standard, but unless the actual procedure is one which does things according to the schedule, the results will not be forthcoming.

In the first place, the first hour or so in the morning is really the most important time in the day. There are a lot of men to be attended to; flasks, patterns and rigging must be distributed, and it cannot all be done at once or to advantage unless there is some organized arrangement. The following plan, therefore, seems to fit:

1—The night force, after the regular night work as outlined is done, should (according to the schedule furnished the night foreman) place on the moulder's floors the large flasks that are to be used, in which should be placed the large patterns. If pits are to be used, the patterns should be placed near them. This will lighten the work of the cranes to quite a degree.

2—About a half hour before the regular starting time in the morning, the laboring force should report and distribute the smaller patterns and flasks.

3—As soon as work is begun in the morning, whatever may be necessary in the way of rigging should be taken to the floors.

4—A man should be placed in charge of the laboring men, whether they directly assist moulders or not, to whom the moulders can make known their wants and he should be held responsible for seeing to it that they get what they want as quickly as possible.

5—There should be a regular place for the supplies, etc., listed previously, and the knowledge of their location should be in possession of all concerned.

6—Facing sand (which should be mixed in advance) should be kept at each moulder's floor and replenished as necessary before (not after) the men may need some.

7—The labor foreman should keep careful watch over the needs of the men as to copes. There is no excuse for a moulder asking for his cope only to find that it is at the bottom of a pile.

8—The moulders should be kept supplied with tools and equipment and should report when they need such things. I recently saw a moulder trying to mend a mould in the dark. Someone had stolen his torch and he was afraid to mention the matter for fear of being called down for his carelessness. There is certainly no money in such a state of affairs.

9—Cores should be furnished the men in advance of their requirements. They should never be made to go for them.

10—The crane service should be watched very, very carefully. "A whole mouthful," a foundry foreman recently said when this was mentioned to him. True, but a study and ingenuity will find ways to keep the delays due to crane waits at a surprisingly low point.

11—The general shop labor should be made to *jump quickly* when moulders want such things as gaggers, clamps, etc. The idea is to save time and if two steps can be taken instead of one, things will be further ahead.

A pretty large contract this? Certainly—an ideal state of affairs—an ideal that many a foundry can come within reaching distance of, if the work is properly organized, in the hands of a hustler and everyone made to do his part. It means work, of course, but no one ever accomplished anything worth while by weak, half-hearted trying.

Why necessary? *To save time that can be utilized in turning out castings.* Do not count by the usually accepted standards—the hours time or the wages expended per hour—but by *the pounds you can produce in every hour saved at the value per pound.* Your men are your investment on which you win or lose. Arrange it so that they can work to the best advantage and you are assured excellent dividends in extra tonnage. They will not only like it, but will show their appreciation by exerting themselves in order to stay with such a progressive concern. You will like it, too, for after all you measure your likes and dislikes in the foundry business by the size of your bank account after you balance up. The suggested procedure will help you to increase it.

# THE ELECTRIFICATION PROBLEM ON TRUNK-LINE RAILWAYS.

*By A. D. Williams.*

Mr. Williams' statement of the problem of railway electrification recognizes frankly its seriousness and points upon which the railway manager must still be convinced by the electrical engineer before any general revolution in methods of operation can occur.—THE EDITORS.

ELECTRIC traction has successfully met several problems of heavy railway traffic, and their solution seems a step toward that eventual electrification of the main line which is the dream of the electrical engineer. However, all these installations have been the result of peculiar local conditions and no two of them are alike, except in the fact that traffic passes through a tunnel. The New York Central Railroad uses the under-contact third rail and 600-volt direct current in the terminal electric zone, while on the West Shore near Syracuse some local traffic is handled by a third-rail installation which will not interchange with the terminal zone. The New York, New Haven & Hartford uses 25-cycle single-phase current at 11,000 volts, delivered by an overhead conductor east of Wakefield, and direct current on the New York Central tracks over which it reaches the Grand Central Station. At the St. Clair Tunnel the Grand Trunk has adopted the single-phase system with an overhead conductor, while the Detroit River tunnel of the Michigan Central uses direct current and the third rail. A three-phase system with overhead conductors has been installed at the Cascade Tunnel, while the Pennsylvania Company uses the third rail and direct current for their New York Terminal. All of these installations operate through tunnels. The Illinois Central, however, has indefinitely postponed the electrification of its Chicago terminal where tunnel operation did not enter the problem, and the railroads centering at Boston, Massachusetts, have reported that electric operation would be so excessively expensive that it was practically prohibitive—a conclusion similar to that reached by the Illinois Central.

The electrification of a trunk line carrying a diversified and heavy traffic is not a simple matter, and many of the problems which must be met and overcome are so far beyond the province of the specializing electrical engineer that he does not seem to realize the vital

bearing which they have upon the electric-traction problem. The electric-traction engineer has been trained in the design, construction, and operation of street-railway systems and interurban lines upon which the traffic and operating conditions are radically different from those met with upon railroads. Upon these arteries of commerce all classes of traffic must be accommodated and kept moving, and any interruption in the service for an extended period results in serious industrial complications throughout the territory served. A delayed passenger train spoils many opportunities. To the general public this is the only evidence of railway operating difficulties, and it is usually dismissed with the comment "That qualified train's late again," unless there is a wreck and a newspaper article. Freight wrecks are unnoticed, generally, except by those to whom the goods are billed. It is only when some general strike or a natural cataclysm has paralyzed the railroads that the people commence to realize how dependent upon them they are. Under the most favorable conditions railroad operation is not one dream of bliss, even on a four-tracked main line, and the odds against the operating official increases as the number of tracks decrease. When the track goes out before the irresistible hand of natural forces beyond control, then traffic must be detoured; but it cannot be stopped as long as there is any possible means of getting it to its destination. This may mean a few or several hundred of miles extra run for passenger trains and for perishable freight. With steam as a motive power, each train is an independent unit and can be run as long as fuel and water are procurable and the track is in any shape to put a wheel over it.

It is true that the foregoing is an emergency measure, but the railroad official knows it is not uncommon, and the ability to cope with such obstacles to operation is inherent upon the ideal simplicity of operating each train from its own power plant. Herein lies the advantage of the standard gauge and the uniform equipment diagram to which practically all the steam railroads of the United States conform. The steam motive power and the cars of one line can be operated over any other line.

When the subject of electric traction is approached a diversity of systems is found in actual operation, and other and as yet untried systems are advocated as affording substantial advantages over those now in use. The railroad executive, keenly alive to the vital necessity of a uniform system upon all lines, is naturally bewildered and perplexed by these strenuous advocates, each presenting some favored system and condemning its competitors by faint praise. Some one system of electric traction must be the best, and all others will ulti-

mately be relegated to the scrap pile; but he is called upon to choose between direct current at two voltages, and single-phase or three-phase alternating currents of a wide variety of frequencies and potentials, the electrical company offering to supply any variety desired, but not taking any decided stand for a particular system. It is imperative upon the railroad to be conservative; every item of equipment must be paid for and must earn enough to pay for itself and its replacement. The apparatus which cannot meet this requirement before it lands in the scrap heap will result in an enormous deficit, and bankruptcy with its attendant financial disaster, carrying down thousands of the holders of stocks and bonds to ruin, will be the fate of the road which hazards its future upon unsound and questionable progress.

Unlike the electrical engineer, the railroad man realizes that the existing installations of electric traction were made to meet extraordinary operating conditions; that these installations are widely separated, and so located that in the case of a breakdown of the electric system steam motive power can be rushed into the electric zone from adjoining divisions. Already one case has arisen where this step was necessary, as a snow slide carried away all the overhead construction at one end of the Cascade Tunnel and swept all the electric locomotives down into the gorge. It was announced that electric operation would be interrupted for several months by this accident.

With steam traction all kinds of emergency operating conditions can be readily met, as the motive power of one road can be operated over adjoining roads, and with electric operation it will be absolutely necessary to have equipment of an interchangeable type, for the reason that it could hardly be expected that a connecting line would be able to supply motive power for the trains detoured over its lines as well as for its own trains. Current for operating it might be able to supply, but only by serious limitations on the number and weight of trains, though assistance on this score might be feasible by the interconnection of power plants. Trackage rights are all that can be expected in a case of this kind and trackage without motive power cannot be used. It is true that the single-phase locomotives of the New Haven Road are operated for a portion of their run upon the tracks of the New York Central with 600-volt direct current, but in this case the motors were especially designed for this purpose and means are supplied for the control of both direct and alternating current. It can hardly be claimed that a locomotive of this kind is the ideal of simplicity. The New York Central locomotives cannot be operated except in their own electric zone. Should it ever become necessary to

send trains down the west side of Manhattan Island, owing to the blocking of the inlet to the Grand Central Station, this could be done at the present time by the use of steam locomotives, abandoning the electric at Spuyten Duyvil.

It is undoubtedly true that each of the systems of electric traction possesses advantages for certain peculiar classes of work, but railroad traffic cannot be governed by fixed laws; it varies from day to day, and motive power and cars must be shifted from division to division to handle it. In passenger service, a football game at New Haven, or the boat races at New London, mean in addition to the regular daily schedule from sixteen to twenty extra trains of about nine cars each each way to carry the crowd, besides the addition of extra cars to the regular trains. All this extra traffic is crowded into a very short period and the difficulties of handling it with a supply of motive power just adequate for normal conditions is something which cannot be appreciated by the layman. Freight congestions rarely reach such a stage that the public becomes aware of their existence, but on occasions the Pennsylvania Railroad has been forced to place an embargo on perishable freight for certain points. In the west emergencies have arisen which caused the Denver and Rio Grande to lay out express passenger trains in order to rush train loads of coke to the smelters on passenger schedule. Upon more than one occasion the second section of the famous 18-hour train has been a fast freight carrying silk or the new tea for Transatlantic shipment. The lesson of the emergencies is that any motive power of a specialized character must be very carefully considered, and its zone of service so delineated that it will never prove the neck of the bottle.

Before any real progress in electrification can be made the battle of the various systems must be settled upon broad-gauge lines. The motive-power question is one of the biggest problems in railroading. It offers one of the most attractive fields for speculation on its progress, and the electrical man sees in it the prospects of an enormous amount of business; for this reason the advocates of electric traction must not permit themselves to become blinded by its brilliancy. The efficiency of electric traction is not a question of systems, but of cold cash. Will it pay? In the settlement of this question operating expenses, safety, flexibility, first cost, depreciation, interest, and the financing charges must all be considered. The number of cycles, phases, and the kind of current are of no importance whatever to the big railroad man, the one who must be convinced. In order to get his attention it is necessary to eliminate all the details and reduce the problem to the limits of a single letter sheet.

# THE TWELVE PRINCIPLES OF EFFICIENCY.

*By Harrington Emerson.*

## IX. THE SEVENTH PRINCIPLE: DESPATCHING.

Mr. Emerson's formulation of the definite principles of efficiency, which began in our issue for June, 1910, is attracting a growing momentum of interest and appreciation. It is exercising a force upon industrial thought that promises to influence materially the economic future of production, transportation, and the engineering activities generally. The first five principles—Definite Ideals, Common Sense, Competent Counsel, Discipline, The Fair Deal, are principles of conduct. The remaining seven—Reliable, Immediate and Adequate Records, Despatching, Determination of Standards, Standard Practice Instructions, Standardized Conditions, Standardized Operations, Efficiency Rewards—are principles of operation. Mr. Knoeppel's article, elsewhere in this issue, (page 745) shows how this seventh principle—Despatching—is practically applied in foundry operation.—THE EDITORS.

THE Eskimo counts days by sleeps, counts months by moons, and counts years by long snows. He despatches himself by the seasons. The Egyptians knew that days varied in length, that the moon was no despatcher of seasons, and that the sun was no despatcher of the year, so they fell back on Sothis, the dog-star, and based their chronology on the great Sothis period of 1,461 years. Our watches and chronometers run on sidereal time.

With our photography, with our spectroscopes, we find that in one direction the stars are widening out, that in the opposite direction they are drawing together, as our solar system swings through space; and ultimately we shall fall back on the whole universe as chief despatcher.

So much for the infinitely large; but despatching is just as much in evidence in the infinitely little.

In three weeks' time, a hen's egg, if kept warm, will change from an albuminous and fatty mass into the living chick. As boys in an English school we secured cards of silkworm eggs, hatched them by the heat of our own bodies, carefully reared the worms, watching the alternate periods of voracious activity and sloughing numbness. We watched them spin their cocoons, within which they changed to crysalids, to emerge later as delicately beautiful moths—unless we cut short their despatching and despatched them our way with boiling water. All growth and decay are manifestations of the principle of despatching. The emanations of radium, that marvelous element,

have almost revealed to us the ultimate constitution of matter, and we now know that every atom is in a ferment of activity, as orderly as and perhaps far more complicated than a solar system.

The Egyptians had wrested from the stars their time secrets and arranged accordingly their dynasties, also their great Sothis month once in 120 years, a leap-year month; but they did not know that ophthalmia is carried by filthy flies and that it grows in each case as regularly as solar cycles. So from the prehistoric paleolithic age to the last decade, Egyptian babies have gone blind with preventable blindness.

It is apparently easier to grasp and acquiesce in the large than in the small, easier to rush to certain death in a battle than to endure a cinder in the eye, but he that ruleth his spirit is better than he that taketh a city.

At every hotel there are racks filled with railroad time-tables. These are issued by the ton every month and show to the minute the exact time during the future weeks every passenger train in the United States is scheduled to reach every station. These are the popular, abridged time-tables. For the employees there are time-tables much more carefully compiled, covering also the freight trains and giving all the rules of operation.

In railroad operation marvelous despatching has been attained, more accurate than the seasons, more reliable than the tides, almost equal to the star time on which it is based. Lines of track nearly a thousand miles long stretch between New York and Chicago. Every switch, every grade, every curve, is known; the line is studded with signal towers and punctuated with stations. In the round house is a locomotive with boiler capable of carrying 225-pounds steam pressure, which through the cylinders and pistons pushes on the wheels with rims polished like glass. The rims transmit 400 horse power through a quarter-inch square of contact with a glass-smooth rail. With one load of coal, drinking from tanks as it runs, the locomotive is able to speed 140 miles at the rate of 60 miles an hour. The seventy-two to eighty-four wheel axles under the train must each run true in its box, everything in track and equipment, in men, and above all in spirit, must be in perfect order all the time. On the basis of these conditions a schedule is made out, a schedule of running time, with due allowance for grades and curves and stations, an 18-hour schedule from New York to Chicago. The train is then despatched.

The despatchers issue orders to the conductor and to the block-signal men, thus controlling the train from both ends. While under

the orders of the conductor, while physically under the control of the engineer, it is the despatcher who from start to finish holds it in the hollow of his hand. This is the highest degree of despatching that has been reached in America. It is perfect in its way, and all Americans are justly proud of it, although as a marvel of human skill and despatching excellence it is not to be compared with the despatching of the Franco-German war by von Moltke, when over a million men were despatched, and empire-making and destroying battles were fought at a predetermined time and place, with predetermined victory for the great despatcher, predetermined defeat for his less skilled opponent. The big task was carried through because of perfect preparation. The German army had no track, no perfect locomotives, no built and tested signal towers, but it had a perfectly working organization that had not omitted to give attention to every little detail.

In America we fail in details. We step from the 18-hour train and we enter a railroad shop. We ask, "Do you despatch your work here?"—"No, this is a repair shop. We rarely do the same thing twice. Despatching is all very well for a daily train running every day in the year, but it would never apply in a repair shop." The official in charge with ill disguised skepticism enquires whether the questioner is a railroad man, whether he understands the peculiarities of railroad operation. We say nothing, but we wonder whether a surgeon without railroad experience could take out a railroad man's appendix. Has the official fully grasped the fact that as to most of life facts, as to the fundamentals of conception, gestation, birth, nutrition, growth, development, he is one with his cousins, the other mammals; that as to most of the balance he is one with his human brothers, and that even if he had the special talent of a Paderewski, he could not play without hands, nor compose if he had the toothache, nor appear in public barefoot. We wonder that the official does not see that the laws of order, of sequence, of rhythm, of balance, and several others are superior to all minor peculiarities. Once when I was suddenly stricken in a railroad shop and was taken, distorted with pain, in an ambulance in my grimy, disheveled clothes to the railroad hospital, they thought I was a tramp who had fallen off a brake beam, but neither I nor they were worried about my official standing as they tried to mitigate the sufferings of a sick man.

To return, not to this railroad shop, but to the other where the doubting official is standing, I suddenly see a man shaping a small piece of steel about the size of a visiting card. I do not know what it

is for, but in thirty seconds I notice that the moving tool is cutting air three inches and cutting metal one inch; efficiency of stroke is therefore about 30 per cent, with due allowance for clearance at each end. I ask the man what kind of tool steel he is using, and he answers "blue chip," but this means nothing to him, as instead of making blue chips his metal chips are dull grey. His cutting speed is about one-third of what it ought to be, therefore efficiency of speed is 30 per cent. His tool is diamond-pointed and his feed is 1/64 inch. He should have used a round-nosed tool and the feed should have been 1/16 inch, so that the efficiency of feed is 25 per cent. His depth of cut is as thin as he can make it, so he takes three so-called roughing cuts and then a finishing cut when one deep roughing cut and a broad, scraping, finishing cut would have answered. His efficiency on depth of cut is not over 50 per cent. The time efficiency of the whole job is therefore $30 \times 30 \times 25 \times 50 = 1.125$ per cent—but a little over one per cent. These are the visible inefficiencies. I surmise a number of others that I do not see. I suspect that perhaps the piece was not needed at all, that some worker or foreman is doing some unauthorized experimental work; I suspect that the piece needs no such finish. I have too often seen infinitesimal cuts, followed by file and emery cloth, put on a piece that is then flung down on the rough floor and badly dented with no apparent interference with its usefulness. I have seen a scraping tool put on locomotive tires, taking off tissue-paper-thin scrapings, when everybody who thinks a minute knows that car axles (a much more important surface) are often given a rolling finish, and that locomotive tires, however rough, would roll smooth before the engine had rolled out of the shop. I have seen a railroad shop man put hours of work and use $600 of material on a replacement when a $27 repair would have abundantly answered the purpose, a man not heeding the Scripture injunction not to put a patch of new cloth on an old garment lest the garment be weaker than before. Why continue these painful examples?

The railroad that despatches its crack trains with 99 per cent of time accuracy has either no despatch system or a very crude one for work, either big or small, through its shops; therefore in some cases it fails to realize an efficiency of even 1 per cent, and on the big average of all shop work fails to realize either a time or cost efficiency of more than 40 per cent. Our universe would not last very long if only the stars were despatched. It is the despatching of our daily meals, the despatching work of ferments, of bacteria, of protozoa, of molecules and of atoms, that counts.

A firm in Chicago has taken a million-dollar contract to bring out a new edition of a great encyclopedia. All the work is despatched. Conditions were standardized, operations were standardized, each volume, each page, each column, each line, each letter is despatched, even as the proper lubrication of each car axle is part of the proper despatching of the 18-hour train.

Many years ago on the Yukon I said to a river-steamer owner, "I suppose you much prefer passengers to freight. If you run on a sand bar, the passengers can get off and help you to put the steamer afloat." He told me plainly, forcibly and picturesquely that I did not know what I was talking about. If a passenger boat stuck on a bar, the passengers did nothing but grumble and cause trouble, and the only way they lightened the load was by eating more of the food, but a load of freight would not complain if it not only ran on a sand bar but in addition was caught in the ice all winter.

Railroad despatching as to passenger trains is of a very high order of excellence; as to freight forwarding it is gradually emerging from the dark ages, perishable freight going forwards almost with passenger regularity; wrecks, slides, snow are taken care of with a despatch of the highest order of excellence; railroads are even built on schedule time; but considering the expenditures that are not despatched and those that are inefficiently despatched, the general despatching efficiency, even of railroads, is not over 40 per cent, yet there are few activities that do as well as railroads. The reasons the despatching efficiency is so low are many, but chief among them are lack of proper type of organization, and failure to apply principles as distinguished from empirical makeshifts.

Nevertheless there are very few other activities scheduled as far in advance and as accurately as train despatching. Newspaper offices furnish wonderful examples of scheduled work, so also do theatres, and perhaps the most wonderful of all are the weather reports, gathered over an area of four million square miles, compiled, digested and distributed within a few hours of receipt. But most of the industrial plants of the world are still in the stage of civilization of which as to transportation the old freight wagons and prairie schooners across the plains were types. They started when they got ready, they arrived some time, and nobody knew where they were nor what route they were taking in between.

There is one collection of industrial shops in the United States in which schedules and despatching have been so perfected that the work is planned ahead three months and the particular job that each

man is to do at 4 o'clock or any other hour for any day is known. Planning long in advance is convenient, but is not an essential part of scientific despatching. A barber shop is scientifically despatched from minute to minute, and a customer entering can figure very closely on the time that he will be able to leave.

Railroad despatching remains, however, the most extended and striking example of advance planning and daily realization. It seemed quite obvious, therefore, to extend these railroad principles of despatching to the operations in a railroad shop. Railroad officials fully understood what despatching meant, were accustomed to work under its rules. It proved nevertheless a very difficult task. In the running of trains a very great deal precedes despatching. There is a carefully worked out schedule which has been more or less tried out for months. How many of these conditions are present in the industrial shop? Where are the standardized conditions, where are the standardized operations? Where is the discipline, where is the maintenance, and where are the schedules?

Railroad shops as to despatching are in the same backward condition as most industrial shops. Therefore it was found that despatching by itself could not be applied, that many other preparations were necessary, that if the application of other principles was worked out, despatching would become easy.

The application of principles will change a mob into an army, whether in field or shop. The frenzy of a mob shows itself in a lynching, but the courage of an army ought to be highest in defeat. When men, foremen, officials, equipment, supplies, had been subjected for a year to the operation of principles, a beginning was made of despatching locomotive repairs. The subject was attacked from both ends at once. Locomotives were worth a great deal to the road, a day's service being estimated at $35; therefore the first plan was to despatch the repairs as a whole, locomotives to be returned to service in 12 days, 18 days, 24 days, according to the class of repair. The second plan, worked in with this, was to despatch each separate item of work and to pick out those items which, taken at the proper time, in the proper order, and in the proper sequence, would result in completing a locomotive in the shortest time.

It is interesting to note in the matter of repairs the great superiority of marine repair despatching over locomotive repair despatching. A big vessel will be put in a dry dock, at $5,000 a day charge perhaps, and be completely scraped, repainted, new propeller and rudder fitted, new plates inserted, in perhaps three days. Complete

circulating pumps, from drawing to installation, will be completed in three days. Where individual operations are summed up, many of which can go on concurrently, it is hard to defend a longer time than 72 hours for most locomotive repairs.

It is also interesting to note that in the sister branch of railroad maintenance, namely, track repairs, stupendous tasks of snow and landslide removals, bridge rebuilding, etc., are accomplished in hours rather than in days or weeks.

It is evident that brain must count for more than muscle in attempting to apply despatching to locomotive repairs. We had to know that men would be available, therefore discipline and the fair deal both had to be strengthened; ideals of order, of promptness of economy had to be instilled; common sense had to be applied; records had to be started, but other principles also had to be applied. Conditions of all kinds had to be standardized, operations had to be standardized, schedules had to be made out, and definite instructions had to be issued. It is really very much easier to apply a few principles than to remedy several million defects. The easiest way is to forget these defects in the past, ignore them for the present, but constantly obviate them for the future.

A new plan was gradually substituted for the old plan. In the railroad shop major schedules were worked out and put into effect by despatching; minor and subsidiary schedules were made out for each job, each man, and each machine, the lesser jobs fitting like parts of a puzzle into the larger schedules, and on the basis of schedules, however often they were changed, men, machines and jobs were despatched. All work, instead of passing directly from foreman to worker or to gang, passed through our despatch board. Practice was perfectly elastic, but procedure was not. Schedules could be changed on a moment's notice and also the sequence of despatching, but not the fact of despatching. The particular shape and size and location of despatch board is unimportant, the essential being that it is suited to the work. Whether the despatch board is covered with parti-colored strings, or made up of hooks, clips, or pockets to receive cards, is also unimportant in principle, but not in practice, since a method under which many of your despatching cards blow out of the window soon becomes inoperative.

The name *despatching* was adopted from train despatching, and train operation organization was adapted. The foreman corresponded to the engineer, a new official was created corresponding to the despatcher, a messenger and telephone service kept the despatcher's

office in touch with the work. Despatching records, however, were adapted from bank practice. The receiving teller takes in money, he enters the amount in the depositor's time book, he credits the bank's cash book with the amount received, but he also credits the ledger account of the depositor. When the depositor draws a check it is presented to the paying teller who hands out the cash, charges the cash account, charges the depositor's account. At the end of any day the total cash in hand must correspond with the sum of the balances in all the accounts. Similarly the despatching board, like the cash book, is filled with prospective work. As fast as any item is performed it is charged to the order. The operator is charged with the pay he draws and credited with the work he performs.

There must be at the day's or week's or month's end a perfect balance between all work credited to operators and charged to orders, also a perfect balance between wages and other accounts charged and totals credited to work in progress and delivered since last balance. The records are immediate, absolutely accurate, and wholly adequate.

In practice it has proved more important to despatch unstandardized work than to standardize undespatched work, even as on railroads it is more important to despatch trains even if there is no adherence to schedule than it is to run trains on time without despatching.

Despatching, like other principles, is a subdivision of the science of management, a part of planning; but while visible to the eye as a distinct pattern, it ought, like inlaid work, to be intactile. If we are well nothing is more beautifully despatched than the food we eat, from plate to building up of depleted hidden tissue. We are only conscious of the pleasure of the first taste, not conscious of the admirably regular way each molecule is ultimately despatched to its destination.

# EDITORIAL COMMENT

### A Critic of Efficiency.

A CONFUSION of ideas and a fallacy of argument appear in Mr. Warren S. Stone's address before the National Civic Federation at its recent. conference. Mr. Stone is quoted as asking, about an advocate of efficiency: "Has he ever shovelled coal into a locomotive? No; and yet he makes the assertion that the railroads waste half their coal. I have shovelled more coal into locomotives than could be piled on two of your city blocks."

To measure a man's knowledge of possible economy in fuel combustion by the tonnage of coal he has shovelled is a good deal like testing the skill of an architectural engineer by the thousands of brick he has laid or, better, taken up the ladder. Has he ever carried a hod? No; and yet he asserts that steel construction is more efficient than brick!

There have been many betterments in the efficiency of fuel combustion in stationary steam plants during the past twenty-five years, and the best today probably saves half the coal used in the good average practice of a quarter-century ago. The waste of fuel was due to imperfect apparatus, appliances, methods, knowledge—not to wilfulness of the firemen. None of the betterments was made by the men who shovelled coal through the fire doors. None of them has increased the labor of the men who shovelled the coal. Many of them have lightened that labor. None of them has lessened the number of jobs for firemen wanting work. On the contrary, the reduced cost of power has increased enormously its use and the number of firemen employed.

If similar improvements had been made in locomotive firing, so that one city block full of coal could do the work of two, Mr. Stone's labor of shovelling would have been only half as exhausting, while his pay would have been the same. The other block full of coal would have been conserved for productive uses, employing other men. Mr. Stone's job would have paid just the same, and some other man would have got a job at equal pay shovelling the other half of the coal. The value of that second city block of coal would have remained in the railroad treasury to do useful work, employing more men. It is hard to see how even from the most selfish interests Mr. Stone can so savagely insist upon shovelling that second city block full of coal, and refusing to have any one save it or save him from the 50 per cent of useless, profitless waste.

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### Anti-Machinery Riots Modernized?

ANOTHER official expression from the railroad employees has been voiced by P. H. Morrissey, president of the American Railroad Employees and Investors Association, and P. J. Dolan, general secretary of the International Brotherhood of Steam-Shovel Men. They say: "The suggestion (scientific management) contemplates the reduction of the operating force by thousands of men. . . . They (the unions) want more men to lessen their burdens, instead of less men and greater burdens." And so forth. It is the old blind cry that labor has always raised against mechanical (i. e., scientific) improvements. The stage-coach drivers at the beginning of the nineteenth century opposed the railway with the same objections, with the same earnestness, in almost the same words, that Messrs. Morrissey and Dolan present today.

Efficiency methods do not impose greater burdens; they lighten existing burdens by removing the difficulties, the

obstacles, the useless and fruitless efforts and movements that so generally lie between the man and the actual accomplishment of his job. The causes of inefficiency where labor is concerned are not generally that the employee does not work hard enough, but that a large part of his work is expended on wholly useless things that do not profit him or any one else—Mr. Stone's firing all day long, for instance, twice as much coal as should suffice.

It may of course be argued that where labor is concerned this must result in fewer men performing any fixed quantity of productive work, and therefore in throwing oī some men out of work. Theoretically, the proposition is correct. Actually, it is the opposite of truth. This is partly because the quantity of work is *not* fixed, an enormous increase of demand always appearing as soon as the work is more economically done. It is partly because these changes never proceed and never can proceed by sudden revolutions, but by slowly progressive evolutions; and the labor which is released from the old wasteful effort is immediately and progressively absorbed by the increasing opportunity for the new and more efficient effort.

There can be no such rapid introduction of efficiency methods that the country will run any risk of being "plunged into industrial warfare" by these Tories of industrial politics, who have so long held the old labor-union creed that they can not understand, and hence they fiercely denounce, the statement of a new gospel that is full of hope for the whole country, and most of all for labor The progress toward more scientific management will be gradual, spreading quietly from many centers of growth. It is interesting even now to note that while those who feel themselves subservient to railroad interests are, as they believe, catering to those interests by violent attack upon the principles and the preachers of efficiency, some of the greatest railroad men in some of the greatest railroads of the United States are giving these principles and preachers their serious, respectful, and conscientious attention.

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**State Aid to Technical Education.**

AN earnest and able argument for substantial State appropriations in support of the Massachusetts Institute of Technology has been made by its President, Dr. Richard C. Maclaurin. The "Tech," as he shows, is an institution founded by the State, bearing its name, with State representation in its governing body, doing work for which similar institutions elsewhere receive large State support, and at present contributing directly about $200,000 per annum in excess of all tuition fees for the education of the youth of Massachusetts.

To maintain high standards of efficiency and quality in engineering education, a constant and large increase must be made in personnel, equipment, and facilities. The technical school that does not meet these requirements is retrograding, and the utmost devotion and work by its teaching staff can only partially and temporarily check the rate of the decline that results from stationary or parsimoniously increased appropriations. The Massachusetts Institute of Technology recognizes this need clearly, and turns to the State as the natural provider of the funds that it seems difficult to secure elsewhere.

President Maclaurin makes his case. He ought to have the money if he wants it. Nevertheless, it would be happier to see the funds provided from some other source. State—or any political—affiliations do not seem good for a university in the long run. The connection may not be proven, but there seems to be risk in accepting State aid, and with it by implication increased State control, and another solution of the financial problem, if possible, seems desirable; but this is a consideration to be weighed by the Institute and not by the State.

# REVIEWS-ADVANCED PRACTICE

NOTABLE ARTICLES OF THE MONTH IN THE SOCIETY PROCEEDINGS AND TECHNICAL PRESS OF EUROPE AND AMERICA

## THE CLINKERING OF COAL IN BOILER FURNACES.

A GENERAL VIEW OF THE SUBJECT, AND A SUMMARY OF RESULTS OF TESTS FOR THE EFFECT OF VARIOUS CONSTITUENTS IN THE ASH.

*Lionel S. Marks—Engineering News.*

SCIENTIFIC experiment has had little to do with the development of knowledge of the causes of the clinkering of coal and of means for its prevention or reduction. The information at present available is almost entirely based upon the results of general experience, and while it is satisfactory so far as it goes, it does not meet the demands of modern boiler practice. Special interest attaches, therefore, to a long paper on the subject by Prof. Lionel S. Marks, contributed to *Engineering News* for December 8, 1910. Prof. Marks' investigations, it is true, have given results which are almost wholly negative; he offers no universal remedy for clinker troubles, and no means of palliation except the use of the well known steam-jet apparatus. But his clear exposition of the whole subject, and the authority of the conclusions he draws from his scientific research make his paper none the less a very interesting and valuable contribution to power-plant literature.

The objection to clinkering is mainly economic: it increases the cost of the heat liberated from the coal by decreasing the efficiency and capacity of the furnace, by increasing the labor cost, and by shortening the life of the fire bars and of the fire-brick lining. Occasionally it may interrupt entirely the operation of an industrial plant by clogging up the moving parts of a moving grate. From the point of view of the coal user, there are two principal methods of reducing the economic loss due to clinkering. The first is by drawing up coal specifications in such a way as to penalize a clinkering coal in proportion to the loss it will cause; this method, however, presupposes the possession by the coal user of information not at present available—information which will enable him to predetermine, by tests on a sample of a coal, the behavior of the coal in the boiler furnace. The second method is by reducing the clinkering resulting from the normal combustion of any given coal. Prof. Marks' investigations have had for their principal object the determination of the conditions under which clinkering can be diminished, or modified and controlled so as to give less trouble. He discusses also the possibility of obtaining the information required for the application of the first method mentioned.

Clinkers result from the fusing of the ash content of coal, and it is presumably true that the amount of clinkering depends on the composition and amount of the incombustible residue, and also, probably, on the amount of sulphur present. While it must be borne in mind that the caking of coal, determined principally by the hydrocarbons, may have considerable influence on clinkering, it seems permissible to disregard the car-

bon, hydrogen, oxygen, and nitrogen, except in so far as their relative or absolute amounts may determine the temperature of the fire. The incombustible matter, upon which the clinkering mainly depends, may be divided, according to origin, into four classes. The first class includes the ash originally in the wood from which the coal is derived, which may be generally expected to amount to 1 to 1½ per cent. of the weight of the coal, and to comprise, on the average, 0.3 per cent. carbonate of lime, 0.2 per cent. magnesia, 0.15 per cent. phosphates, and 0.3 per cent. silicic acid. The second class of incombustible matter includes the material, generally argillaceous and siliceous, deposited as silt among the fallen wood from which the coal is derived, which must be considered as part of the true ash of the coal, and which is in fact the origin of the greater part of the ash in ordinary clean coals; this class includes also the salts of calcium, silicon, and other metals precipitated in the wood, the probable origin of most of the sulphur in coals. Calcareous, siliceous, or argillaceous material from the walls of a coal seam, the result of careless mining and washing, constitutes the third class of incombustible matter. The fourth class comprises accidental additions of iron, dirt or other foreign matter to the coal in transit.

If the coal from any given source clinkers always under normal operating conditions, it may be assumed that the clinkering results from the presence of the true ash, and there is no difficulty in obtaining a fair sample of the ash which is giving the trouble. If clinkering is only occasional, it will be due either to a higher temperature than usual or to other changes in conditions, or else to the presence of impurities of the third and fourth classes mentioned above. When the presence of impurities of the latter classes is the cause of clinkering, it is practically impossible to get a fair sample of the ash, because of the unequal distribution of the impurities throughout the mass. The detection of causes of occasional clinkering is consequently very difficult.

Certain attempts have been made to relate the clinkering of coal to the chemical composition of the ash. With the object of finding whether there are any general characteristics of coal ash, Prof. Marks has searched the literature of the subject for all available chemical analyses in all parts of the world. A thorough examination of the data collected fails to reveal anything that may be regarded as a general characteristic of coal ash, as distinguished from ordinary rock substance. The number of constituents is always large and the variation in the percentage present of the various constituents is extreme. With this enormous variation in the composition of the ash it seems hopeless to expect that any set of investigations of practicable extent could clear up the relation between the composition and the clinkering of ash.

"Clinkering is the result of fusion and is some function of the fusibility of the ash. But it is impossible to consider fusion without taking viscosity into account. The fusing temperature of an ash is not necessarily, is not generally, a single-valued temperature. At some particular temperature, some one constituent of the ash will melt; if it is a minor constituent the effect may be that the ash becomes a very viscous pasty mass. At higher temperatures other constituents may melt and the mass will become more liquid. In other cases the ash may become liquid as soon as the initial melting temperature is passed. It is evident that the viscosity of the melt will have an extremely important influence on clinkering. If the melt is very viscous, we shall get a sticky mass which will attach to itself the surrounding coal and ash and form a troublesome clinker; if it is more fluid it will run on the grate bars and will in part freeze there and may be difficult to detach; if it is extremely fluid and melts at a temperature very much below that of the fire, it might possibly flow from the fire like water and give very little trouble.

"There is in existence some information as to the fusing temperatures of ash materials of various compositions,

but this information would have to be enormously extended before it became useful for the study of clinkering. Moreover, even if such information were fully available, it would necessitate the tedious and costly analysis of the ash before it could be applied; and even then, in the absence of exact knowledge as to the temperatures that would be reached in the fire, it would not be possible to foretell the behavior of the ash in an actual furnace. The very important question of viscosity is practically uninvestigated. Consequently, it appears that it is now, and probably always will be, quite impracticable to approach the subject of clinkering from the analytical side; and that little is to be gained from ash analysis unless it can be shown that certain fluxes are present in considerable amount."

Prof. Marks summarizes present knowledge and theories as to the formation of clinker and discusses Prost's formula for the relation between the fusing temperature of coal ash and the composition. He finds it unsafe to rely upon Prost's method. The general idea —that the temperature of fusion is increased by increasing the alumina and is decreased by substitution for alumina of other constituents—is undoubtedly sound; but in the present state of knowledge it is impossible to tell from a chemical analysis what will be the fusing temperature and how much trouble will arise from clinkers.

A very common view as to clinkering is that it is due to, or accompanies, sulphur in coal. The influence of sulphur is undoubtedly considerable in some cases, but the clinkering depends on the percentage of sulphur in the ash rather than the percentage of sulphur in the coal. When the percentage of sulphur in the ash is high, much clinkering is likely to result. Another common view is that clinkering is caused by iron. The presence of iron certainly results in a lowering of the melting temperature, and so far as the presence of iron means the presence of sulphur, there may be that secondary reason for clinkering. It is probable that the fire bars waste away wherever contact takes place with molten iron or with ordinary molten clinker, in two ways: first by direct melting, and second by chemical combination or solution. The latter is undoubtedly the more active agent, since the chemical combination or solution will in general result in a lowering of the melting temperature of the cast iron, and may be accompanied by evolution of heat.

Since it is impossible to predetermine, by chemical analysis, the degree of clinkering which is likely to result from the burning of a given coal under a given boiler, search must be made for some means of preventing or reducing clinkering, or, failing in this, means of preventing or reducing the loss of efficiency of combustion which results from clinkering. Four possible courses seem open:

1. Reduction of the temperature of combustion by increasing the air supply to the furnace. This will always be accompanied by reduction in efficiency, but badly clinkering coals should always be burned at low temperatures, as the reduction in efficiency from a large excess of air will not usually be so important as the losses from bad clinkering.

2. Prevention of freezing of clinkers on the grate by the use of steam blown in from below the grate. The steam is decomposed by the grate and the clinker, and not only prevents the clinker from freezing on the grate, but also tends to break the clinker into smaller masses. With some clinkers this method is not found to give much relief. The use of steam in this way should not result in any considerable reduction in efficiency.

3. Raising the fusing temperature or viscosity of the ash by mixing certain substances with the coal so as to prevent either the fusing of the ash or the flow after fusing.

4. Reducing the fusing temperature and viscosity by the admixture of various fluxes, so that the fused material will flow through the grates like water without freezing on them.

Prof. Marks' investigations have been devoted exclusively to remedies 3 and 4. The operation of remedies 1 and 2 is well known. The investigations were of two kinds: first, with the ash alone;

and second, with coal burning on a stationary grate. In the first series, which was intended to be merely preliminary to the second, ash and mixtures of ash with alumina, lime, sesquioxide of iron, iron pyrites, iron filings, calcium sulphide, and calcium sulphate were moulded into pyramids of the dimensions of Seger's cones and were heated in a gas muffle. On the observation of their behavior was based the selection of the materials mixed with the coal for the tests on the stationary grate. These materials were kaolin, pure silica, common yellow loam, crushed oyster shells, which had the same effect as lime, and three iron compounds, pyrites, limonite, and the simple sulphide. Both the kaolin and the crushed quartz materially reduced the clinker trouble, the lime caused very bad clinkering, and the tests with the iron compounds showed that both the iron and the sulphur cause trouble. Since neither kaolin nor crushed quartz is cheap enough to be commercially available, the results of the investigations have a purely negative value. Prof. Marks' conclusion is that the only real cure for clinkering is low-temperature combustion, obtained either by increased air supply or by the use of the steam jet.

An editorial on Prof. Marks' paper in the same issue of *Engineering News* enters at length into the question of the economy of steam-jet apparatus. Their comparative disfavor among engineers is due partly to the extravagant claims with which they have been exploited, and partly to their reputation as "steam eaters." An excessive steam consumption, however, is usually the result of negligence. With efficient steam jets, well maintained, it should be possible to deliver an amount of steam into the ash pit sufficient to prevent clinker without serious reduction in boiler economy. There is, in fact, considerable reason for believing that the presence of water vapor in a furnace does in some way tend to promote combustion. If it reduces the percentage of carbonic oxide in the flue gases, or the air necessary to secure complete combustion, the loss due to the passage of water vapor through the furnace may be more than offset.

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## THE TESTING OF STEAM TURBINES AND TURBO-GENERATORS.

A CRITICAL DISCUSSION OF THE VARIOUS METHODS, THE APPARATUS EMPLOYED, AND THE PRECAUTIONS TO BE OBSERVED.

*E. D. Dickinson and L. T. Robinson—American Institute of Electrical Engineers.*

IN a paper read at the December, 1910, meeting of the American Institute of Electrical Engineers, E. D. Dickinson and L. T. Robinson have given a highly practical review of methods of testing steam turbines and turbo-generators, of special interest to operating engineers. The authors point out that to those operating steam turbo-generators the only tests of commercial value are those made to determine the over-all economy of the complete unit. Their paper is a summary of the precautions which must be taken in order that the results may not be misleading, and a critical examination of the relative degrees of accuracy of different methods employed in tests of this character. Throughout they emphasize the necessity of exercising the greatest care in every detail of measurement.

The only positive method of testing a turbo-generator is to measure the steam that goes in through the throttle valve, and the electrical energy delivered at the terminals of the generator. The surest way of measuring the steam is to collect and weigh all the steam after it has been condensed; this method, of course, requires a condenser of the surface type. Two precautions are essential: first, that all the steam used in the turbine should be condensed and measured; and, second, that no steam or water not used in the turbine be allowed to enter the condenser. Leakage from the condenser tubes is a common source of error, and when it arises

from split tubes which open only when the condenser is heated by the passage of steam, leakage is very difficult to determine. The condenser should be tested for leakage before and after each test; with all the steam turned off the turbine the condenser should be run for some time with full vacuum, and the discharge from the hot-well pump very accurately measured. No tests should be considered which do not show consistency with other tests on the same machine. The most accurate method of measuring the condensed steam is by the use of tanks so arranged that all the water can be weighed at equal time intervals during the test. The pump, piping and tanks must be free from leaks, and it is essential that the condenser and pumps be so arranged that the water will flow continuously to the pump.

When the turbine operates non-condensing or the condenser is of the jet type, recourse is frequently had to the method of weighing the water fed to the boilers. In tests of this kind the liability to error is very great, and every possible precaution must be taken to secure results of even reasonable accuracy. The steam piping connecting the boilers and turbine must be disconnected from all other piping and all openings must be blanked off; valves must not be relied upon. The outlets of all blow-off and drain valves must be visible. All piping between the feed pumps and boilers must be exposed and have no branches. The boiler leakage, which is most difficult to locate, must be checked before and after each test by closing the throttle to the turbine, or, if necessary, by blanking the pipes at the turbine and running a test measuring the amount of water required with full steam pressure on boilers and piping. The feed water used should be weighed and not measured by meters.

The method of testing by heat balance is based on measuring the amount of heat transferred to the cooling water from the condensed steam. On account of the difficulty of measuring the quantity of cooling water and its true average temperature change, the method is extremely inaccurate and unreliable, and at best can give but an approximate idea of the quantity of steam being condensed, even when all possible precautions are taken in the measurement of the quantity and temperature of the cooling water and the temperature of the outgoing water.

All tests should be run with fixed conditions for an appreciable time after a state of equilibrium has been established. The time required will depend on the nature of the test being made. In general, when small amounts are being measured, as in testing for condenser leakage, the duration of the tests should be somewhat greater than when large quantities are dealt with.

The net over-all efficiency expressed by the ratio between the kilowatt-hour output of the generator and the available energy in the steam is the only one of any particular commercial value. The data required for the determination of the available energy in one pound of steam comprise the pressure in pounds per square inch, the quality and temperature of the entering steam, and the pressure at the turbine exhaust. The last quantity should not be measured by an ordinary gauge, but by a full-length mercury gauge. If the steam be superheated the assumed figure for the specific heat should be given. In testing multi-stage turbines, measurements of the pressures in the different stages should be made, to reveal any abnormal conditions existing in the interior. The kilowatt output should be the net output after subtracting from the total output the kilowatts used for excitation.

All instruments, including meters, gauges, thermometers, and scales, must be very accurately calibrated or checked before and after the test. The turbines should be thoroughly inspected to see that all parts are in proper condition.

Whenever possible, turbines should be tested under the conditions for which they are built to operate. Corrections for different conditions are always liable to throw some doubt upon the accuracy of the test and therefore upon the efficiency of the machine tested. Different machines will have different

correction factors for varying conditions, and for this reason it is impossible arbitrarily to fix the proper allowances. In general, corrections for steam pressure, moisture, or superheat, large changes in which affect only slightly the conditions in the machine, are less likely to be misleading than a correction for varying vacuum, since a slight change in the vacuum makes an enormous change in the available energy and volume of the steam in the low-pressure end of the turbine. A turbine which shows high efficiency with poor vacuum may, unless properly proportioned, show a low efficiency with good vacuum.

The majority of commercial tests on turbo-generators are made to determine whether or not the unit is fulfilling the guarantees made by the manufacturer. The complete test of a unit necessitates taking a large number of measurements, and small inaccuracies in taking many of the readings are liable to affect considerably the final results. For this reason, no machine should be discredited on account of small variations in the final results. With the high efficiencies now being obtained, small inaccuracies in readings will show a relatively large per cent. variation in the steam consumption. For this reason manufacturers guarantee an efficiency which is not quite so good as may be expected from the unit, or else guarantee the efficiency that may be expected, with an allowance to cover permissible inaccuracies in making tests.

Turning now to the measurement of the electrical output in connection with turbine tests, and considering first the measurement of direct-current output, station instruments provided in connection with the generator switchboard should not be used unless temperature conditions can be very accurately controlled and the instruments can be checked under operating conditions. Ordinary direct-current ammeters are especially liable to errors introduced by variations in room temperature. Precise measurement of direct-current output requires the use of portable indicating ammeters having, say, 200 millivolt drop shunts which permit the use of indicating millivoltmeters whose circuit consists largely of resistance material having practically no temperature co-efficient. When possible, also, it is desirable to measure volts by similar portable voltmeters. Especially if the instruments are not of the shielded type, they must be protected against the influence of stray fields. Further, care should be taken to correct the observed indications of the millivoltmeter for any electromotive forces that may appear in the shunt or leads due to thermo-electric effects. The amount of error due to this cause may be observed by reading the millivoltmeter at the close of the test with no current flowing in the main circuit, and a correction should be applied to the observed ampere readings.

The precautions which should be taken with direct-current instruments to eliminate disturbing influences are of even more importance in the measurement of alternating-current output. In the latter case also the current leads of the circuit under test may become a source of error. If the output is small, less than, say, thirty kilowatts, wattmeters, ammeters and voltmeters without current or volt multipliers may be used. While the station instruments and instrument transformers can be properly checked and employed for the precision test, it is usually more convenient to insert transformers specially tested for the work. In using instrument transformers it is necessary to observe the precaution to have the secondary connected load the same as that used in the standardization test. In tests under conditions that will give low power factor on circuits, it is necessary to make sure that the phase displacements in the instrument transformers are not large enough appreciably to affect the results. Further, it is well not to use instrument transformers with interconnected secondaries except for the common ground connection used for the sake of safety.

If possible, a test should be made on non-inductive load. In this case the indications of the voltmeters and ammeters may be used to check the indications of the wattmeters. If the test

cannot be made at unity power factor, the voltmeters and ammeters should still be included so that the general conditions of load distribution, etc., may be known throughout the test. The use of watt-hour meters for this class of testing should be avoided wherever possible. The very best watt-hour meters that can be made are inferior in performance to the best portable indicating instruments. They should never be used unless checked in place at the frequency, voltage, wave shape, etc., which are to be used in testing. Checks of watt-hour meters should not, for precision purposes, be made with the meter subjected to other than exact load conditions and on the same circuit. If watt-hour meters are carefully tested in place and indicating instruments are employed and read at frequent intervals during a test run of three to five hours, the watt-hour record should agree with the output as determined by the indicating instruments within one per cent. on a fairly steady commercial load, with the chances largely in favor of the correctness of the indicating instruments. Single-phase indicating instruments for polyphase service are to be preferred for precision work to polyphase instruments. Single-phase instruments are required for determining the division of load between the two elements of polyphase instruments; since they are required for this purpose they may as well be of the precision class and used for the actual determinations.

## THE DISPOSAL OF TRADE WASTES.

A STATEMENT OF THE PRINCIPLES GOVERNING THE DISCHARGE OF INDUSTRIAL WASTES INTO PUBLIC WATERWAYS AND SEWERS.

*George A. Johnson—New Jersey Sanitary Association.*

CONTAMINATION of the waters of streams and lakes by industrial wastes is in certain districts a problem of little less importance than the pollution caused by sewage. With the growth of large manufacturing centres it may be expected rapidly to increase in importance, and George A. Johnson has recently stated before the New Jersey Sanitary Association that the problem of trade-wastes disposal is becoming every day more difficult of entirely satisfactory solution. A large part of the difficulty, he says, is due to the practical impossibility of strictly interpreting the term "riparian rights." Riparian owners frequently claim an unqualified right to discharge trade wastes into a stream without any attempt at prior purification, a practice which may render the water unfit for use by individuals or communities farther down stream. Further, the granting of such a right may confer an unfair advantage over other manufacturers, not riparian owners, who are obliged to purify their wastes for discharge into public sewers. We are not concerned here, however, with the legal aspects of the problem but with the technical principles which should govern the discharge of industrial wastes into public waterways and sewers.

"The seriously complicating factor in the trade waste problem is the wide and sudden variation in the composition of the wastes, not only in different factories but in a single factory. It is impossible to lay down hard and fast rules to govern the degree to which all wastes must be purified before they are discharged, for the simple reason that each problem must be considered in the light of the surrounding conditions, and the remedial cloth cut to suit the local requirements.

"Probably the most important feature requiring consideration is the amount of solid matter which the wastes contain, expressed not in the terms of the analyst as so many parts per million but more comprehensively as tons per day or per year. It might almost be said that if all trade wastes were to be treated before their discharge to the extent of removing the suspended solid matters, the

trade-waste problem would be nine-tenths solved. Of course there are cases where spent dyes, for example, would render a stream unfit for use by some industries, and where large volumes of antiseptics in a clarified waste liquor which was allowed to enter the public sewer system might seriously interfere with the treatment of the sewage at the purification works. But it nevertheless remains a fact that if such solids as dirt, hair, soap and grease, tar, wool, malt and solid refuse from breweries and distilleries, were first removed, the resulting liquor, in the vast majority of cases, would cause little if any trouble at the purification works; and except where the volume of such wastes is greatly out of proportion with the stream flow, the liquid wastes would speedily become purified and be practically unobjectionable.

"It is not possible or expedient to exclude from rivers the wastes of manufacturing industries. Some depreciation in the quality of the water in the stream is inevitable, but the use of moving bodies of water for trade-waste disposal should be permitted to the greatest practicable extent, so long as actual nuisance is avoided and the public health is not endangered. It is fortunate that in the large majority of manufacturing wastes the element of danger coming from the presence in such wastes of pathogenic germs is usually a minimum.

"Under practically all circumstances, the disposal of trade wastes means their discharge into the nearest waterway or into public sewer systems. In the latter case the question arises: To what degree must such liquors be purified before they may properly be admitted into the public sewers? As a rule this means the removal by the manufacturer of the suspended solid matters in the wastes. As already stated, these matters undoubtedly represent the greatest objection to the discharge of such wastes into public sewers or public waterways. There are cases, however, where certain germicides present in the wastes affect prejudicially the subsequent purification of the domestic sewage with which the wastes are mixed.

"Permission for the manufacturer to discharge his wastes into public sewers may be hedged in by a number of provisions which offer many opportunities for varied interpretation by the different parties interested. In general these are that the wastes shall not injure the sewer, that is, contain substances which will actually injure the structure; further, that the wastes shall not affect prejudicially the subsequent purification of the sewage, meaning by this that they shall not add abnormally to the solid content of the sewage, or to its content in grease, tar products, etc., or certain germicides which will destroy such bacterial life as is absolutely necessary for the proper and sufficient purification of the sewage by artificial methods; and finally, and perhaps most important of all, that the trade wastes shall not abnormally affect the capacity of the sewer.

"Taking these points up in order, it appears that little apprehension need be felt with respect to the possible effect which any trade waste may have upon the sewer itself, so far as causing actual damage to the structure. It is true there may be cases where the wastes are so strongly acid that there may be brought about a disintegration of the structure, but such cases are rare.

"The prejudicial effect which wastes may have upon the subsequent purification treatment is one which frequently requires some careful consideration, for the destruction of beneficial bacterial life precludes efficient purification by artificial methods. Wastes which contain arsenic, for instance, if such germicides are present in relatively large quantities, should be treated by the manufacturer before they are discharged into the sewer. A simple method of removing the arsenic is to pass the liquid through a layer of iron filings or coke. Speaking broadly, trade wastes and domestic sewage are probably best and most economically treated together. When the complete purification of wastes alone is attempted many complications arise, for it may perhaps be stated as a general proposi-

tion that trade wastes are not amenable to biological purification.

"Wastes which contain large quantities of solids like hair, lime, gas, tar, grease, distillery refuse and other similar wastes, should have such substances removed to the greatest practicable extent before the wastes are discharged into public sewers or into public waterways. Such solids, if allowed to enter the sewers with the liquid wastes, may produce clogging, and are almost certain to be a somewhat expensive proposition to remove at the purification works, especially if these works do not contain ample facilities for preliminary sedimentation.

"The question of when trade wastes may be admitted into public sewers is a serious and difficult one to discuss. In scattered urban and rural districts the volume of trade wastes is frequently so great as to upset the whole sewage system on account of the disproportion of the wastes to the sewage. It is a difficult problem to proportion the cost of a certain sewer to each user thereof. If the apportionment is on the basis of the actual volume of sewage which each user discharges into it, the manufacturer, who is usually the biggest taxpayer, is the hardest hit, and frequently will not only flatly refuse to pay such a proportion of the cost, but will even defend extended litigation in the courts intended to compel him to do so.

"To what extent, and under what restrictions, may public waterways be used for the reception of unpurified trade wastes? Obviously the public health must not be endangered; the flow in the stream must be sufficient at all times to disperse speedily and allow the purification of such wastes to a degree where public and industrial water supplies will not be affected prejudicially; and, finally, the wastes must not be of such a composition that they will form unsightly and otherwise objectionable sludge deposits in the bed or on the banks of the stream. To live up to all of these requirements, each problem must be considered by itself in the light of all the surrounding conditions. It is impossible to state a specific remedy to cover all cases."

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## MODERN GRINDING PRACTICE.

A SUMMARY OF RECENT IMPROVEMENTS IN MACHINERY AND METHODS FOR ORDINARY AND PRECISION GRINDING.

*B. M. W. Hanson, W. A. Viall—American Society of Mechanical Engineers.*

LAST month we reviewed in these columns the first of three papers on grinding read at the recent annual meeting of the American Society of Mechanical Engineers. C. H. Norton, the author of the paper in question, introduced the subject by a discussion of the field for grinding in machine-shop practice; our review gave an extended abstract of his exposition of the economy of grinding in comparison with the removal of metal by turning or milling in certain classes of work. The other two papers, abstracted at length below, dealt with recent improvements in machinery and practice for ordinary and precision grinding.

Modern grinding methods are summarized in the paper by B. M. W. Hanson. "The designers of grinding machinery," he says, "have had a good many problems to solve. Different materials require different speeds and on the modern grinding machine there must be various speeds for the grinding member as well as for the traverse movement of the work; and for the revolution of the work in the case of the cylindrical grinder. Machines must be designed with water pumps, and the working parts must be protected from water as well as from the grit which comes from the grinding wheel. The grinding member usually moves at a high rate of speed and must have carefully designed bearings which will run freely, yet not allow any back lash, as true surfaces can only be obtained when the work and the re-

ducing member move against each other in fixed positions.

"The grinding machines now used can be divided into two large groups; machines for cylindrical grinding and machines for grinding flat surfaces. Cylindrical grinders are well known and have been highly developed by four machine-tool builders in this country. The other style of grinder, the surface grinder, is best known as a planer type machine, with a wheel grinding on its periphery, and fed across the surface in much the same manner as a tool is fed across the surface on a planer or shaper. Another type is the vertical surface grinder with a cup-shaped wheel working in much the same manner as an end mill on a vertical milling machine.

"In doing work on lathes or milling machines, it is comparatively easy to reproduce several pieces to the same dimensions by adjusting the machine to a size. This is possible because the reducing member, which is the turning tool, will resist wear for a considerable length of time without making any difference in the size of the work. With grinding machinery this is more difficult since the reducing member is constantly wearing away at a rapid rate. For very close work it is necessary to readjust the machine for every piece to be ground, which of course requires skill and time on the part of the operator."

Mr. Hanson describes a recent device for controlling the size of the work, no matter how much the reducing member wears away. The feed of the reducing member is controlled electrically; when the work has reached the desired size, which can be predetermined by suitable adjustments, the machine will automatically throw out the feed. With this machine any number of pieces can be ground to practically the same diameter, say within one-quarter of a thousandth of an inch. An operator can manipulate more than one of these machines, and he requires comparatively little skill to get uniformity of size. Another device described by Mr. Hanson is a back rest which automatically advances at exactly the same rate that the diameter of the work is reduced.

TABLE I. GRINDING LIMITS FOR CYLINDRICAL PIECES

AS ADOPTED BY BROWN & SHARPE MFG. CO.*

| Diameter. | | |
|---|---|---|
| **RUNNING FITS—ORDINARY SPEED.** | | |
| To ½-in., inc. | 0.00025 to 0.00075 | Small |
| To 1 -in., inc. | 0.00075 to 0.0015 | Small |
| To 2 -in., inc. | 0.0015 to 0.0025 | Small |
| To 3½-in., inc. | 0.0025 to 0.0035 | Small |
| To 6 -in., inc. | 0.0035 to 0.005 | Small |
| **RUNNING FITS—HIGH SPEED, HEAVY PRESSURE AND ROCKER SHAFT.** | | |
| To ½-in., inc. | 0.0005 to 0.001 | Small |
| To 1 -in., inc. | 0.001 to 0.002 | Small |
| To 2 -in., inc. | 0.002 to 0.003 | Small |
| To 3½-in., inc. | 0.003 to 0.0045 | Small |
| To 6 -in., inc. | 0.0045 to 0.0065 | Small |
| **SLIDING FITS.** | | |
| To ½-in., inc. | 0.00025 to 0.0005 | Small |
| To 1 -in., inc. | 0.0005 to 0.001 | Small |
| To 2 -in., inc. | 0.001 to 0.002 | Small |
| To 3½-in., inc. | 0.002 to 0.0035 | Small |
| To 6 -in., inc. | 0.003 to 0.005 | Small |
| **STANDARD FITS.** | | |
| To ½-in., inc. | Standard to 0.00025 | Small |
| To 1 -in., inc. | Standard to 0.0005 | Small |
| To 2 -in., inc. | Standard to 0.001 | Small |
| To 3½-in., inc. | Standard to 0.0015 | Small |
| To 6 -in., inc. | Standard to 0.002 | Small |
| **DRIVING FITS—FOR SUCH PIECES AS ARE REQUIRED TO BE READILY TAKEN APART.** | | |
| To ½-in., inc. | Standard to 0.00025 | Large |
| To 1 -in., inc. | 0.00025 to 0.0005 | Large |
| To 2 -in., inc. | 0.0005 to 0.00075 | Large |
| To 3½-in., inc. | 0.00075 to 0.001 | Large |
| To 6 -in., inc. | 0.001 to 0.0015 | Large |
| **DRIVING FITS.** | | |
| To ½-in., inc. | 0.0005 to 0.001 | Large |
| To 1 -in., inc. | 0.001 to 0.002 | Large |
| To 2 -in., inc. | 0.002 to 0.003 | Large |
| To 3½-in., inc. | 0.003 to 0.004 | Large |
| To 6 -in., inc. | 0.004 to 0.005 | Large |
| **FORCING FITS.** | | |
| To ½-in., inc. | 0.00075 to 0.0015 | Large |
| To 1 -in., inc. | 0.0015 to 0.0025 | Large |
| To 2 -in., inc. | 0.0025 to 0.004 | Large |
| To 3½-in., inc. | 0.004 to 0.006 | Large |
| To 6 -in., inc. | 0.006 to 0.009 | Large |
| **SHRINKING FITS—FOR PIECES TO TAKE HARDENED SHELLS ⅜-IN. THICK AND LESS.** | | |
| To ½-in., inc. | 0.00025 to 0.0005 | Large |
| To 1 -in., inc. | 0.0005 to 0.001 | Large |
| To 2 -in., inc. | 0.001 to 0.0015 | Large |
| To 3½-in., inc. | 0.0015 to 0.002 | Large |
| To 6 -in., inc. | 0.002 to 0.003 | Large |
| **SHRINKING FITS FOR PIECES TO TAKE SHELLS, ETC., HAVING A THICKNESS OF MORE THAN ⅜-IN.** | | |
| To ½-in., inc. | 0.0005 to 0.001 | Large |
| To 1 -in., inc. | 0.001 to 0.0025 | Large |
| To 2 -in., inc. | 0.0025 to 0.0035 | Large |
| To 3½-in., inc. | 0.0035 to 0.005 | Large |
| To 6 -in., inc. | 0.005 to 0.007 | Large |
| **GRINDING LIMITS FOR HOLES.** | | |
| To ½-in., inc. | Standard to 0.0005 | Large |
| To 1 -in., inc. | Standard to 0.00075 | Large |
| To 2 -in., inc. | Standard to 0.001 | Large |
| To 3½-in., inc. | Standard to 0.0015 | Large |
| To 6 -in., inc. | Standard to 0.002 | Large |
| To 12 -in., inc. | Standard to 0.0025 | Large |

* The limits given in the table can be recommended for use in the manufacture of machine parts to produce satisfactory commercial work. These limits should be followed under ordinary conditions. Special cases should always be considered, as it may be desirable to vary slightly from the tables.

"Surface grinders have usually been made with the wheel grinding on its periphery and in some instances it may be necessary to continue to do work on this principle, as grooves and irregular shapes sometimes have to be ground and the thinness of the wheel makes it possible to get into narrow places; but when flat surfaces are wanted, the cup-shaped wheel has taken a foremost place in grinding. The wheel covers the whole width of the work at once and water is forced through the center of the spindle, centrifugal force throwing the water outward and compelling it to pass between the work and the wheel. It is astonishing with what rapidity work can be reduced to a flat surface under this process.

"This method of grinding would never have been successful if it had not been for the advancement in wheel making. The wheel problem in connection with the machine has been most difficult. It has been found very essential to select the right kind of wheel for different classes of work and for different materials. For grinding steel, either hardened or soft, corundum wheels have proved the best and for grinding cast iron the carborundum wheel has proved the best. The different degres of hardness must be taken into consideration when the width of the surfaces to be ground varies."

The latest type of this machine has a table stroke of 6 feet, and can grind a piece 6 feet long and about 25 inches wide, and circular ring or disk surfaces up to 30 inches in diameter. Mr. Hanson gives the following comparison of the capacity of a grinding machine having a cupped wheel for grinding flat surfaces with a machine having a wheel grinding on its periphery and working on the principle of a planer:

"The traversing speed of the work or the work table can be assumed to be the same. If a piece is 6 inches long and 3 inches wide, the machine grinding on its periphery will take about 48 strokes to cover the surface, assuming 1/16 inch feed for each stroke. The cupped-wheel machine will do the same amount of work with one stroke or in about 1/24 the time. These proportions are essentially true on hardened steel or on any kind of work where a nice finish is required."

W. A. Viall dealt with the subject of precision grinding. "The principles of grinding, in the main, are not difficult to grasp, and the time that would be required of the ordinary chief operator in grasping them is not excessive. But the work does require such attention and knowledge of the results that can be obtained, coupled with the skill acquired by experience, as to class it with the arts. In the early days it seemed quite necessary that for every different piece of work we should have a different wheel. Later it was found that a given wheel would give satisfactory results on various kinds of work by varying the speed of the wheel, the speed at which the work was run, or the feed of the work, so that one wheel answered a great variety of purposes. There have been changes in abrasives and we are getting to-day a far better quality of wheel than was possible some years ago. The grading of wheels has very much improved, and although in the writer's opinion it is not possible to obtain an absolute grading, this element has been reduced to such a nicety that it need not be taken largely into account by the average operator.

"The first use of the grinding machine as we know it to-day was to correct slight errors that were impossible of eradication by means of the file and emery cloth. To-day the grinding machine rectifies these errors and in addition finishes work for appearance and fit in a relatively cheap manner. After the proper machine has been selected, the choice of wheels requires some specialized knowledge which the makers of machines and wheels are in a position to furnish to an extent that many of the users of machine tools are probably not aware. When the proper wheels and gradings are once established for a given line of work, their subsequent use is very easy.

"The question of speeds and feeds is also the result of experience, and suggestions from the manufacturers will help users to a great extent in obtaining

TABLE 2. LIMIT GAUGES FOR LATHE WORK.

| Size. | Not Go On. | Go On. | Size. | Not Go On. | Go On. | Size. | Not Go On. | Go On. |
|---|---|---|---|---|---|---|---|---|
| | Inches. | | | Inches. | | | Inches. | |
| 3/8 | 0.383 | 0.387 | 15-16 | 0.9455 | 0.9495 | 1 1/2 | 1.508 | 1.512 |
| 7-16 | 0.4455 | 0.4495 | 1 | 1.008 | 1.012 | 1 9-16 | 1.5705 | 1.5745 |
| 1/2 | 0.508 | 0.512 | 1 1-16 | 1.0705 | 1.0745 | 1 5/8 | 1.633 | 1.637 |
| 9-16 | 0.5705 | 0.5745 | 1 1/8 | 1.133 | 1.137 | 1 11-16 | 1.6955 | 1.6995 |
| 5/8 | 0.633 | 0.637 | 1 3-16 | 1.1955 | 1.1995 | 1 3/4 | 1.758 | 1.762 |
| 11-16 | 0.6955 | 0.6995 | 1 1/4 | 1.258 | 1.262 | 1 13-16 | 1.8205 | 1.8245 |
| 3/4 | 0.758 | 0.762 | 1 5-16 | 1.3205 | 1.3245 | 1 7/8 | 1.883 | 1.887 |
| 13-16 | 0.8205 | 0.8245 | 1 3/8 | 1.383 | 1.387 | 1 15-16 | 1.9455 | 1.9495 |
| 7/8 | 0.883 | 0.887 | 1 7-16 | 1.4455 | 1.4495 | 2 | 2.008 | 2.012 |

satisfactory results. It is only under proper conditions, however, that these results can be obtained. The wheels must be true and they must not be forced into the work to too great an extent, for this produces a torn effect on the work.

"In considering a piece of work to be done, first of all the question arises as to the size and limits suitable for the purpose for which it is intended. Table 1 gives the limits used at the Brown & Sharpe Company's works for varying conditions. There are special cases where it may be necessary to alter these limits, and this table is not offered as the final word but as a guide towards selection.

"The second necessity is that sizes should be established to which the work should be rough turned ready for the grinding room. In the Brown & Sharpe works, as in all factories, the aim is to produce the desired results as cheaply as possible. The desired ends have been accuracy and nicety of finish where the parts ground are for fits, and nicety of finish where no fits are required. To do this work as cheaply as possible we believe that it is economical to turn the pieces to about the sizes indicated in Table 2. It will be noted that we allow from 0.008 inch to 0.012 inch in diameter, an amount easily obtained by the ordinary class of lathe help. In order to make this work as easy as possible for the lathe department we furnish limit gauges. We are aware that practice varies on this point, and we have thoroughly endeavored to try out the plan of allowing correct limits, but we have found it fully practicable to hold the lathe to the limits given. By so doing we obtain the finished product free from all tool marks and at what we believe is the minimum cost."

## THE PLAN FOR RAISING THE WRECK OF THE "MAINE."

A CRITICAL DISCUSSION OF THE ARMY ENGINEERS' PLAN FOR RAISING THE WRECK OF THE "MAINE"; THE DESIGN OF COFFERDAMS FOR VERY DEEP WATER.

*Engineering News.*

PROBABLY no engineering work ever undertaken by the United Government has aroused the sentimental interest of the American people to the same extent as the raising of the wreck of the battleship "Maine" which was sunk in Havana harbor in 1898. Sentimental considerations have governed the decision to raise the wreck instead of removing the obstruction to navigation by blowing it to pieces and dredging out the wreckage. The recovery of the bodies of the sailors who lost their lives in the explosion which wrecked the "Maine" is the main object of the costly work of raising the vessel intact. The plan adopted by the army engineers, however, has much more than a sentimental interest, although its adoption was governed wholly by sentimental motives. The plan involves a long step forward in the design and construction of cofferdams in very deep water and on a very soft bottom; for this reason it merits the close study of engineers. The problem is very clearly put in an editorial discussion of the project in *Engineering News* for December 29, 1910, which we abstract at length.

"The problem is to surround the wreck of the vessel, about 325 feet in length, lying in 37 feet depth of water, with a

dam which shall be tight enough and strong enough to enable work to be safely carried on under its protection. This dam must be self-sustaining. There is no way of bracing it to resist the water pressure behind it by struts against its interior. The borings show that for a depth of 18 to 20 feet the bottom of the harbor is a soft semi-liquid mud. Below that for some 25 to 30 feet there is a soft blue clay. The building of a dam which will withstand a head of 37 feet of water on such a foundation is a task so unprecedented that it may well excite the interest of engineers generally. The dam must not only be self-supporting and safe against the pressures to which it is exposed, but it must be capable of complete removal after it has served its purpose. It must, moreover, be able to support more or less superposed loads. Upon it must be built some sort of working platform from which can be carried on the work of unwatering the area which it encloses and from which afterwards men and materials can be transferred to the interior for work upon the wreck.

"The plan which the Board of Army Engineers has adopted is to sink around the wreck a series of large cylinders of interlocking steel sheet-piling. These cylinders are to be 50 feet in diameter along the sides of the wreck and 40 feet at the bow and stern. The sheet-pile cylinders are to be sunk to a depth of 70 feet from the surface, which means that their lower ends will have about 33 feet penetration in the bottom. After these cylinders have been sunk, a dredge will dig clay from shoals in the harbor and deposit it in hopper scows. These scows will be towed over to the cofferdam, and their loads of clay will be deposited in the cylinders until they are full.

"Consider, first, the stresses that exist after the cylinders are filled with clay and before the area enclosed by the dam is laid dry. Each cylinder may be compared to a grain-bin or a standpipe, and we may proceed to compute the bursting pressure due to the weight of the soft clay tending to open the cylinder at the joints between any two of the interlocking piles. Under the circumstances in which it is placed it seems certain that the clay will be so soft and will flow so readily that it will act very much like a liquid in producing horizontal pressure. After considering the formulae in common use for pressures on grain-bins and on ordinary retaining walls, it seems to us that under the conditions existing in these cylinders at Havana it will not be safe to assume a pressure due to the contained mud in these 50-foot cylinders of less than 80 per cent of the full pressure which would exist if the mud were a perfect liquid.

"The saturated clay with which the cylinders are to be filled weighs about 120 pounds per cubic foot. At the harbor bottom, in 37 feet of water therefore, the pressure per square foot against the side of the cylinder will be 120 pounds $\times$ 37 $\times$ 80 per cent = 3,552 pounds. The seawater surrounding the cylinder, however, weighing 64 pounds per cubic foot, exerts its full liquid pressure, in opposition to the internal pressure of the clay. This water pressure at the harbor bottom is 64 pounds $\times$ 37 = 2,368 pounds per square foot. Subtracting this from the internal pressure due to the clay filling we obtain 1,184 pounds per square foot as the net internal pressure upon the cylinder at the harbor bottom. On the cylinder 50 feet in diameter this internal pressure will cause a tangential stress of 1,184 pounds $\times$ 50 $\div$ 2 = 29,600 pounds per lineal foot of joint, or 2,460 pounds per lineal inch.

"The Lackawanna steel sheet piling which is being used at Havana, has joints with an ultimate tensile strength, we understand, of about 10,000 pounds per lineal inch. The sheet-pile cylinders, therefore, are apparently strong enough to hold their clay filling until the cofferdam is completed and the process of unwatering begins.

"Let us now consider the stresses after the interior of the cofferdam is pumped out. The interior bursting pressure due to the clay filling remains the same, and the external water pressure is the same on the side of the cylinder next the sea. On the inner side of the cofferdam, however, the water pressure is removed and

tnere is, therefore, a maximum bursting pressure at the bottom of the cofferdam cylinders on the inner side amounting to 3,552 pounds per square foot. This pressure produces a tangential stress on the joints of the steel piling equal to 88,800 pounds per lineal foot of joint, or 7,400 pounds per lineal inch. As the ultimate strength of this joint is only assumed at 10,000 pounds per lineal inch it will be at once evident that the stress contemplated in the design is much too high for safety.

"Further, there may be stresses on this joint from other causes than internal pressure of the clay filling. Loads on the top of the pile cylinder due to the working platforms and anything placed upon them will be carried by the piles as long columns and the tendency of the piles to bow outward when so loaded will produce stress upon the joint. Again, the piles cannot be driven exactly vertical. If the foot of a pile inclines slightly inward as it goes down, the joint between it and the piles on either side will be under compression. If the foot of the pile inclines slightly outward, the joint will be under an initial tension before the filling of the cylinder with clay begins. This initial tension must be added to that caused by the pressure of the clay filling to obtain the total stress upon the joint. . . .

"Let us inquire now concerning the strength of the cylinder as a whole to resist the horizontal pressure of the water on the outside of the cofferdam after the interior is pumped out. The computation of the water pressure is, of course, exceedingly simple. The 50-foot diameter cylinder in water 37 feet deep has an area of $50 \times 37 = 1{,}850$ square feet. The pressure varies from zero at the surface to 2,368 pounds per square foot at the base. Thus the average pressure on the cylinder is 1,184 pounds per square foot, and the total pressure is 2,190,400 pounds, or 1,095 tons, which may be considered as concentrated at a point two-thirds the distance below the surface, or 12 feet from the bottom. The average overturning pressure per lineal foot of the whole cofferdam is about 25 tons.

"What is the strength, now, of the mud-filled steel-pile cylinders to resist this huge horizontal pressure? The empty sheet-pile cylinder itself, manifestly, could not begin to sustain it. The piles would bend over in the soft mud into which they are driven, sliding upon each other at the joints like the staves of a barrel with loose hoops. The interior filling, however, by placing the joints under tension, adds greatly to the strength of the cylinder and in addition has a large resistance of its own. What that resistance is, it is impossible to compute. It depends upon the consistency of the material, and its internal friction. If good gravel were available for filling the cylinders, for example, their strength would almost certainly be ample. On the other hand, if the clay with which the cylinders are filled is slow to give up its water and remains a soft, putty-like, greasy mass, it seems likely that the clay may slowly flow under this heavy pressure and the cylinder may be pushed over until the distortion added to the internal bursting stress will open some joint, allow the clay to flow out and the dam to fall.

"For it must be clear that the opening of any one joint of all the thousands in these steel-pile cylinders will mean the immediate failure of a cylinder and the flooding of the interior of the cofferdam. The clay filling of the cylinders will flow if released, we should judge, at least as readily as grain in an elevator bin; and besides if any joint fails, the pressure will quickly open out the sides of the cylinder to right and left on either side of the break, giving a wide opening for the outflow of the clay. Further, when the clay flows out of the cylinder, the exterior wall against which the water stands will be left unsupported and liable to collapse as soon as the clay is removed to great enough depth."

As a means of increasing the strength and safety of the design now adopted, the engineers in charge contemplate hooping the steel cylinders near the bottom, where the bursting pressure is greatest. Despite the enormous difficulties it might be possible of accomplishment, but even if the hooping were suc-

cessfully done, from the bottom up to a depth of 20 feet or so, where the strength of the unhooped joint might be assumed to be sufficient, it would leave the strength of the mud-filled cylinders to resist the horizontal water pressure still uncertain.

As an alternative to this plan, *Engineering News* suggests the dumping of a mound of coarse gravel or riprap stone along the inner side of these cylinders. Such a mound of stone, particularly if it were of high specific gravity, would exert a heavy counter-pressure to resist both the interior pressure of the clay and the horizontal pressure of the water outside. It would take a large amount of stone, but it could be placed and removed at a low cost per cubic yard, and the total cost would not be a prohibitive percentage of the entire cost of the work.

## THE BUILDING OF THE NEW CANADIAN NAVY.

THE PROBABLE CHOICE OF VANCOUVER AS THE LOCATION OF THE NAVY YARD FOR THE CONSTRUCTION OF THE PROPOSED VESSELS.

*The Engineer.*

ANNOUNCEMENT has been made from Ottawa that contracts for the proposed ships to form the nucleus of a Canadian navy will be let by the Dominion Government in the near future. It is reported that six British shipbuilding firms have been invited to tender for the construction of four cruisers, presumably of the *Bristol* type, and six destroyers, and some Canadian firms also have offered to undertake the work. All of the vessels are required to be built in Canada, and for this reason the contracts for the whole ten will be let to a single contractor. Canada has at present no shipbuilding establishment capable of undertaking a work of this magnitude, and the building of the new navy will involve the establishment of a navy yard of considerable extent.

The probable location of this yard is discussed in *The Engineer* for December 23, 1910. It is reported that "already there are rumors that point to Vancouver, on the Pacific coast, as destined to be the favored locality. It is situated on the finest natural harbor of Canada, and the construction of a large dry dock is to be immediately proceeded with there. Proposals are also on foot for building a floating dock capable of lifting ships of 15,000 tons displacement.

"The Pacific coast offers very many attractions to a shipbuilder. Its harbors are as fine as any on the Atlantic coast, and facilities for obtaining material are good. Coal and iron are obtainable at the very door, and if requisite capital to erect adequate smelting works and rolling mills were forthcoming, the business of steel shipbuilding, which has already reached respectable growth, would receive a tremendous incentive. If it be true that the new Canadian navy is to be built at this port its future as a shipbuilding centre is assured. The coasting trade alone provides a considerable amount of repair work, much of which is at present diverted to other ports from lack of docking accommodation. Such firms as Harland and Wolff, Swan, Hunter, and Wigham Richardson, and others have had representatives on the spot making investigations as to the possibilities of development along these lines.

"Vancouver has one decided advantage over Atlantic ports in its Pacific slope climate, which would render the business of shipbuilding possible all the year round. Burrard Inlet, upon which it stands, seems to possess all the requirements which appeal to the professional and business instincts of the shipbuilder. It is an ideal site for the purpose. The harbor is magnificent, being land-locked, and therefore quite sheltered. Within the First Narrows, known as the Lion's Gate, the shore of the harbor proper, not including the north arm of Burrard Inlet, extends 25 miles, while the width is 2¼ miles. The low-water depth at the wharves is 26 feet,

and in the stream about 30 fathoms. The avearge rise and fall of tide is 13½ feet. At low tide the present entrance to the harbor has a width of 700 feet at its narrowest point. It is, however, to be widened to 1,200 feet, and dredged to a uniform depth of 30 feet to 35 feet at dead low water. A contract has bee.1 placed by the Dominion Government for a special dredger to do this work which will be completed, it is estimated, in about three years, including the removal of some shoals and a projecting reef. At the wharves of the shipbuilding business at present in operation there is a depth of 30 feet of water at low tide, so that war vessels could be afloat at all times.

"Burrard Inlet, then, needs little artificial improvement to make it suitable as a shipbuilding centre, whether for warships or merchant vessels, and it is likely to be a strong, if not the strongest, competitor for the construction of the new Canadian navy. Indeed, the site at North Vancouver, upon which large shipyards are to be erected in the near or more distant future, is practically settled; it is on the north shore of the inlet, where there is plenty of deep water close in shore. The Imperial Dry Dock and Shipbuilding Company has been granted a subsidy from the Dominion Government, and Roche Point has been selected as the site of a new dock. Victoria, 84 miles from Vancouver, has at present the lead in shipbuilding when compared with Vancouver, and has turned out such vessels as the *Princess Royal and Princess Beatrice* for the C. P. R. line. Notwithstanding this, Vancouver appears from its natural suitability for the purpose destined to become the largest shipbuilding and commercial centre on that part of the Pacific coast. It possesses, with the minimum of expenditure a harbor such as many seaports cannot secure at any price. The only shipbuilding now carried on there of any importance is on quite a small scale, but it is up to date so far as its has gone, and although the larger of the two firms employs less than a hundred hands, and it is of quite recent establishment, it is intended to be the nucleus of a much larger concern.

"There are large coal deposits in the immediate neighborhood; a new mining corporation called the Canadian Collieries Company has recently acquired an immense coalfield on Vancouver Island, and has devoted three million dollars to opening up and developing of new mines on their property, and to increasing the output of those already in operation. Mechanical haulage, by means of electric power, generated by a 50,000 horsepower waterfall will be installed, and this source of power will at the same time supply other affiliated businesses.

"It is a trite saying, that progress of trade in a seaport is infallibly indicated by the appearance of the wharves on the water front, and this port is no exception. Her rapidly extending wharfage is generally in a more or less congested condition. In the Vancouver service, Messrs. Alfred Holt & Co., of the Blue Funnel line, as it is termed, maintain a fleet of eight fine vessels. The C. P. R. steamers, and the Andrew Weir line, both run constantly between Vancouver and the Orient. The Canadian-Australian mail service to Sydney is carried on by the Union Steamship Company of New Zealand, and a large cargo business is done with goods from the Atlantic coast and Europe, which are transported across the Isthmus of Tehuantepec by the railway from Puerto-Mexico, to Salina Cruz, and thence re-shipped to ports on the Pacific coast. This latter route is so much cheaper than the trans-continental railway freight, that a consignment of goods from, say, Montreal to Vancouver would be carried via the Isthmus for little more than half the overland railway freight across the Continent.

"Five years, or even three years ago, export of Canadian grain from Vancouver was a dream only entertained by one or two far-seeing and optimistic individuals. About two years ago the probability of Vancouver becoming a great factor in the shipment of grain from Alberta and Saskatchewan began to attract attention, and to-day she is a grain-exporting centre whose output is only limited by the present dimensions of the demand for Alberta wheat. When the

Panama Canal is opened there will probably be a great deflection of the present eastward flux of wheat from Alberta, Saskatchewan, and Manitoba to the western route via Vancouver, with a very considerable saving of time as compared with the lake route. Vancouver harbor is open and free from ice all the year round, and great things are expected of the A. B. C. route—Alberta British Columbia—as a great exporting channel for Canadian grain.

"The growth of the railway systems of British Columbia is commensurate with expansions apparent in other directions, and Vancouver is fast becoming one of the biggest railway centres on the Pacific coast. The question is, will its natural advantages cause it to become the chief seaport of that coast? Basing judgment on its geographical and terminal position, it appears probable that it will. For nearly twenty years the C. P. R. was the only railway entering the city. The Great Northern and the Northern Pacific came later, giving an example likely to be soon followed by others. Three years will see the Canadian Northern connection complete with the East. The Grand Trunk Pacific has engineering parties in the field, with Vancouver as the main objective, and its line will probably be completed within five years. Other subordinate lines are also in construction.

"All this goes to show that the Dominion Government have every reason to favor Vancouver as a likely position for building and equipping their new navy. By the time the first instalment of it is in being, there will be a valuable national asset to protect there, and one can easily imagine how strong an appeal such a natural harbor as Burrard Inlet must make to both the technical and strategical components of the Dominion Government."

## COKE IN FOUNDRY PRACTICE.

THE IMPORTANCE OF ADJUSTING CUPOLA PRACTICE TO SUIT THE CHARACTERISTICS OF THE FUEL USED.

*Richard Moldenke—United States Bureau of Mines.*

THE coke industry of the United States as related to the foundry is the subject of a monograph prepared by Dr. Richard Moldenke for the United States Bureau of Mines, and recently published as Bulletin 3 of the Bureau's publications. The bulletin reviews, with Dr. Moldenke's well known lucidity, the status of the coke industry, some features of practice in the use of coke in the foundry, the probable happenings of a cupola heat, and the reasons for modifying charging practice so that a particular coke can be used to the best advantage. It is to the last of these topics that attention is directed in the following paragraphs. Dr. Moldenke believes that the many troubles laid to the idiosyncracy of the cupola could really be avoided by changing the melting programme to suit the fuel used.

"Normal coke has 50 per cent. cell space and has, pound for pound, practically double the volume of anthracite. Hence during the melt the downward movement of the metal within the range of the melting zone must be twice as fast when coke is used as it is with anthracite. Therefore the difference between the first of the metal to melt and the last, with respect to the influences to which they have been exposed, is greater for a bed of coke as compared with a bed of anthracite of like weight. That is, the first metal to melt is likely to be the same on either the coke bed or the bed of anthracite, but the last metal, especially if the charge is very heavy, melts much lower down in the coke-charged cupola and is necessarily subjected to greater oxidizing influences, because the blast low down in the cupola contains more free oxygen. When anthracite is used the part of the bed where the melting is actually done varies least in position. This advantage is still retained by many foundry men in the East, where anthracite, as it is still available and no

dearer than coke, may be used for the fuel bed and often mixed with coke in the subsequent charges, or even used altogether.

"A study of the downward movement of the metal, as just stated, is important, as it suggests the way to make use, in regular casting practice, of practically every variety worthy of the name of foundry coke. Anthracite and coke, being practically identical in composition—that is, containing the same percentage of ash, fixed carbon, sulphur, etc.—differ radically only in physical structure. Thus, if the cell space of a coke is 50 per cent., as mentioned above, the coke has twice the volume of an equal weight of anthracite. Now, not all cokes have the same cell space, and, moreover, cokes differ in percentage of ash, etc. Hence a given weight of coke varies greatly in volume, and consequently the behavior of charges of iron melted with it also varies. The foundryman when changing his brand of coke makes the mistake of believing that the new kind ought to be handled in the same way as the old. It may be possible to do so if the two cokes have the same characteristics, but if they have not the foundryman is certain to get differences in results, which he usually ascribes to sulphur, high volatile, black ends, and what not. His coke dealer then hears from him. This difficulty is so marked that even when the same brand of coke is bought the year round and trouble results, investigation of the shipments often reveals substitution of coke from different companies located in the same general region. Furnaces have this difficulty to contend with more particularly. It is therefore highly important that the foundry man get his coke from the same ovens and the same coal mines—in fact, have it as nearly the same as it can possibly be made; if a change is desirable or necessary he should be informed, so that he can adjust his work to the changed conditions.

"In this respect the retort-oven coke has a great advantage. After the coals have been contracted for and the proper mixture has been established, the result will continue to be even as long as the coking process is carried out uniformly; and as the highest scientific skill is available at retort ovens, there should be little variation from the standard if the management honestly wishes none. Another advantage of retort-oven coke is the size and shape of the lumps. A retort oven is narrow, and the coking of a charge proceeds from the walls toward the middle; the result is a mass of coke that, when quenched, breaks into short, thick pieces. The absence of thin fingers is decidedly noticeable. In comparison, the lumps of standard grades of beehive-oven coke are generally longer and thinner. Moreover, makers of retort-oven coke have carefully sorted the product before shipment, so that it has contained little breeze and the lumps have been of good shape. The size of the lumps of fuel in a cupola charge has much to do with the progress of the heat, and the absence of thin fingers accounts in a measure for the remarkable success of retort-oven coke when it was first used in foundries. Charges of coke having lumps that are uniform in shape and size give results similar to those obtained by using anthracite, which is marketed in screened sizes, because the uniform sizing of the fuel permits an even and regular penetration of the bed by the blast.

"In order to adjust the process to the varying character of the coke used for melting in the cupola, it is necessary not only to change the melting conditions, for instance, by using a milder or stronger blast according as the coke is light or heavy, but also to change the relative weight of the metal and coke charges on the bed. A foundryman using heavy charges, though he may not know why, avoids coke with a large percentage of volatile matter. Such coke is necessarily underburned and light and ignites rapidly, spreading the melting through too large a volume. Very light charges will obviate much of this trouble, as the bed of coke will be kept more nearly uniform in height, and the melting will be done at the proper point. A coke in which the volatile matter is too high is virtually a gas coke and is too troublesome for use in the foundry, at least for cupola melting. It will serve well enough for all other purposes.

"Coke producers should be urged to make thorough melting tests with their coke, so that when selling it they can advise foundry men how to get the best results with it. This plan would save enormous trouble, as there are about 6,500 foundries using coke in the United States and Canada, and but a very small percentage know how to make comparative tests of coke and draw conclusions therefrom that will guide them in its proper use. There are, on the other hand, comparatively few coke producers, or selling agents for coke producers, and it would pay these firms well to have a central testing station, or a sort of 'trouble bureau,' for coke tests. . . .

"As retort-oven coke, it is to be hoped, will be the foundry fuel of the future, the coke makers, by careful study of details, will probably bring about a very uniform product, with so slight variations in composition and physical structure that it will give uniform satisfaction to the user. In the meantime, however, we have to do with existing conditions. We have coke with low and with high sulphur, coke with low and with high ash, and occasionally coke so soft as to be very near the danger limit. By the very nature of the process of making it coke can not be uniform in structure, and only careful selection from the ovens as they are discharged gives the foundry man what he is paying for. In brisk times this selection is likely to be made less conscientiously, coke forks being discarded or their prongs made closer. Many coke tests have shown conclusively that much can be done to improve a coke by adapting the process of making it to the requirements."

## THE OVER-RUNNING OF DANGER SIGNALS.

A BRIEF REVIEW OF GERMAN TRIALS OF DEVICES FOR THE PREVENTION OF OVER-RUNNING OF SIGNALS SET AT "DANGER."

*M. Hoogen-Zeitung des Vereins Deutscher Eisenbahnverwaltungen.*

EVERY railway accident directly attributable to the over-running of signals set at "danger" renews criticism of the railways for not employing some device for automatically stopping a train which runs past a danger signal. The recent South Orange derailment on the Delaware, Lackawanna & Western R. R. is a case in point. The question has been again raised in the technical press, and the critics of the railroads take the familiar attitude that the prevention of over-running by connecting some automatic-stop device with the danger signal would be a matter of little difficulty. This attitude, however, is not justified by the results of trials of such appliances in the United States and Europe. At the end of three years' work, the American Block Signal and Train Control Board have failed to discover any automatic stop which has, on the whole, seemed to promise an actual gain in railway safety. Their experience has only repeated that of the German railways which have experimented with these apparatus. This is clearly shown in a paper on the results of the German tests, contributed by M. Hoogen to a recent number of the *Zeitung des Vereins Deutscher Eisenbahnverwaltung,* reprinted in the *Bulletin of the International Railway Congress* for November, 1910.

At the request of the Austrian Railway Ministry, the question was taken up by the German *Verein* in 1902. The sub-committee of the *Verein* to which the investigation was referred reported that devices for informing the driver that a signal is at "danger" by means other than those already in use (for example, audible or other signals on the locomotive) were considered advisable, but that such devices should satisfy the condition of being absolutely reliable in their working. No devices fulfilling this condition had been submitted to the committee. Devices for automatically applying the brakes or cutting off steam without the intervention of the driver were reported to be inadvisable.

In adopting this report of the subcommittee in 1904, the technical committee of the *Verein* specified eight conditions which should be satisfied before a device could be considered absolutely reliable:

(1) The device must not only show that the corresponding stationary signal is being approached, and its eventual position at "danger," but also any defects in the device which would prevent its proper action.

(2) As far as stationary signals are concerned, the device must act soon enough to make it possible to stop the train with certainty before reaching the signal in question.

(3) The perception of the signal must not necessitate any previous attention on the part of the driver; on the contrary, the presence of the signal must at once make itself apparent to the driver in an unambiguous way, under all the conditions which may arise on a locomotive. The indication must be given whether the locomotive is running stack first or tender first.

(4) The device may only stop acting if the locomotive is standing still. Any switches are admissible only if they are so constructed that the locomotive cannot be started unless they are in the correct position.

(5) The device must be arranged so that its action cannot be stopped maliciously or unintentionally. The sign must not be given unintentionally by any obstructions on the track, which do not affect the running of the trains.

(6) Unauthorized persons should not be able to put a signal on or to pull it off.

(7) The upkeep and supervision of the device must not be attended with any particular difficulty.

(8) It must be possible to give the stop signal on the locomotive, without any particular difficulty or lengthy preparation, at each of the places so equipped, from any point that may be convenient.

It was not until the end of 1906 that devices sufficiently developed to warrant trial in ordinary working were submitted to the *Verein*. Systematic trials were undertaken by the Prussian State Railways, and of these the trials of double-light distant signals have resulted in the substitution of this type of distant signal for the type formerly used. The results have proved beyond doubt that the visibility of the distant signal in the night time is materially improved by the double-light arrangement. It is probable that an effective distant signal will for a long time to come remain the most effective means for preventing the overrunning of the main signal. Hence it may also be expected that the improvement of the distant signal will make it easier to attend to the stop signals.

In the experiments with combined detonating and visible signals it has been found that the detonation and light produced by the detonators used suffice to attract the attention of the driver. The care of the signals is a simple matter. The cartridges, usually three in number, are placed on the rail by a lever mechanism operated from the signal cabin. The introduction of this machine into the signal circuit, however, caused difficulties in the operation of the signal, and at times the mechanism had to be entirely disconnected. Doubts arose also as to the safety of using detonators near habitations and highways. But leaving these considerations out of the question, the detonating signal, which originally represented a danger or "stop" signal, is hardly suitable for indicating that a distant signal stands at "caution."

Experiments with electrically operated sirens and horns placed in front of the distant signal have not yet been completed. When the head of the train reaches a contact which is placed 300 metres (328 yards) in front of the distant signal, the latter standing at "caution," the siren or horn begins to sound and continues to do so until the head of the train reaches another contact placed 50 metres (55 yards) behind the distant signal. The apparatus is controlled from the signal cabin. The sound of the siren as a rule attracts the attention of the drivers of freight locomotives, but for drivers of passenger and express locomotives it does not seem to be sufficiently loud.

Another electric audible signal indicator is intended to give warning of the approach to a distant signal on the locomotive itself. When the train approaches the distant signal, a brush fixed to the locomotive comes into contact with two fixed contact bars placed next to the track. The armature of a relay on the locomotive drops off, a red disk appears, and an alarm is switched on. The results of trials of this apparatus have not been wholly satisfactory. The contact brushes have been repeatedly damaged by ballast and by other objects projecting into the boundary of the loading gauge, although the steel-wire brushes seem particularly suitable for making proper contacts even when the locomotive oscillates, and for yielding to any obstruction. When running at high speed, the apparatus sometimes fails to act.

The van Braam apparatus attempts to solve the problem by purely mechanical means. When a pair of slippers mounted on the locomotive slide on raised treadles placed alongside the track, a mechanism is set in motion which may be utilized for starting the compressed-air brake, for making a colored disk appear, and for operating a recording instrument. In the trials of this apparatus, the action on the brakes has been eliminated, both to lessen the complication of the apparatus and to avoid the danger of weakening the sense of responsibility and the attention of the drivers. The turning on of the steam whistle is reliably effected at speeds of from about 20 kilometers (12.5 miles) per hour upwards, if the slippers and treadles are in order. Unintentional turning on has occurred. The greatest difficulty, however, has been caused by the breaking of the slippers, due to their striking objects outside the loading gauge proper but very near to its boundary. Further, difficulties have arisen in the connection between the moveable treadles and the distant signals. It seems at the very least very doubtful whether it is possible to improve the treadles in such a way that they will always act reliably, especially under unfavorable conditions in winter. For this reason the experiments are to be continued with fixed treadles or bars instead of moveable treadles having a position dependent on that of the distant signal. The driver will be informed not how the distant signal is set, but only that he is approaching such a signal, just as in the case of the electrical apparatus described above.

The proposal to use wireless telegraphy for transmitting signals to the locomotive has also been taken into consideration. Electro-magnetic waves, which were continually produced at a sending station, were transmitted by induction to the telegraph wires along the track, and from them to a receiver placed on the locomotive. When an approach to a signal was to be indicated, the waves going to the receiver on the locomotive were intercepted by a screen. This brought a wave detector back to the zero position and a colored disk was shown. The experiments have shown that it is possible, within certain limits, to transmit signals to the locomotive. The strength of the waves, however, becomes materially decreased as the distance between the sending station and the locomotive increases. Further, the effect which the screen at the distant signal is intended to produce is produced in other ways—by telegraph lines crossing the railway, by iron bridges, by iron signal poles. It is not yet likely that this apparatus will give useful results

On the other hand good results were shown by the so-called recording alarm, an apparatus intended to record the over-running of signals. A rail contact is placed next the home or block signal. If this is run over while the signal is at "danger," a recording alarm is set ringing at the place from which the signal is operated. In stopping the alarm a counter is advanced one; the over-running of the signal is recorded in this way, and the record makes it possible to investigate every case of over-running. If a signal is over-run at all frequently, the cause can be investigated and any existing unfavorable conditions can be remedied. The results have been so satisfactory that a large number of these recording alarms have already been ordered for German railways.

Summing up the conclusions to be drawn from these trials, Herr Hoogen says that an "absolutely reliable" action cannot be demanded of appliances for the prevention of over-running, and will probably never be expected. But it may with justice be demanded that failures shall be the exception, when proper care is exercised in the care of the track appliances and the rolling stock. This standard has not yet been attained in the case of any of the appliances in question; it may be specially emphasized that it has not been attained in the case of the van Braam apparatus. The automatic protection of trains is, so far, inferior to alternating-current blocking, operated by signalmen.

## AN ELECTROLYTIC OIL SEPARATOR.

A DESCRIPTION OF THE DAVIS-PERRETT ELECTROLYTIC OIL SEPARATOR, WITH DATA OF THE EFFICIENCY AND COST OF OPERATION.

*Ridsdale Ellis—Society of Chemical Industry.*

OIL is carried from engine cylinders by exhaust steam chiefly in the form of fine spray, but also to a considerable extent as vapor. The amount of oil carried by the steam is only one part in five or ten thousand, and hence, however high may be the boiling point of the oil, a considerable part of it, or at least of its more volatile constituents, must necessarily be vaporized. Oil separators of the baffle-plate type successfully remove the oil carried as spray, but, no matter how well they are designed, separators placed in the steam pipe cannot remove all the oil. Tests made at the Massachusetts Institute of Technology show that baffle-plate separators remove about 75 per cent. of the total oil contained in the steam. The remaining 25 per cent. goes to the condensers, and is there precipitated in the water in the form of very minute globules. A very small part of this residue can be separated by flotation, but after the larger drops have risen to the surface, a very stable, if very dilute, emulsion remains. The drops of oil in this emulsion are extremely small, and to their small size is due both the difficulty of separating them and also the properties similar to those of suspensions and of colloidal solutions possessed by the emulsion.

The chief characteristics of such an emulsion are dependent on the fact that the globules are electrically charged, which is shown by the fact that they migrate in an electric field. Not only does the close agreement between the velocity of migration of these oil globules and that of other colloidal solutions indicate that the emulsion may be treated exactly like a true colloidal solution, but the analogy is borne out by the fact that, as these oil globules are negatively charged, they can be precipitated by oppositely charged colloidal solutions —for example, colloidal ferric hydroxide. On this property of the emulsion is based the new Davis-Perrett oil-separating process, a description of which is taken from a recent paper by Ridsdale Ellis before the Society of Chemical Industry, reprinted in *The Electrician* for December 30, 1910.

"This process consists essentially in the electrolysis of the condenser water using iron electrodes, some electrolyte, usually sodium carbonate, being added to the water to raise its conductivity. Whatever the nature of the electrolyte, a basic salt is always produced on account of the alkali formed at the cathode. The precipitate formed entangles the oil globules, so that when the electrolysed solution is filtered all the oil is removed. Complete precipitation of the compounds of iron does not take place all at once, so that if the emulsion is filtered immediately the filtrate often contains colloidal ferrous compounds. If the emulsion is hot, as would be the case with condenser water, this colloidal solution is not formed. If treated cold the electrolysed solution should be allowed to stand for a little time before filtering, the presence of precipitated iron compounds producing the precipitation of the

remainder of the iron. I obtained an analogous result when the oil was precipitated by colloidal ferric hydroxide. In this case I found that above a certain concentration all the colloid was precipitated, however great the excess, that is within limits. From this it appears that the presence of the coagulated colloid brings about in some way the precipitation of the excess of colloid added. The same is true in the case of electrolysis, the colloidal solution obtained being only precipitated in the presence of the coagula. With colloidal ferric hydroxide the precipitation must occur on the surface of the oil globule, and the precipitation, which is apparently catalysed by the presence of coagulated ferric hydroxide, must continue as it began around the oil globule. The fact that the precipitation of the colloidal obtained by electrolysis only takes place in the presence of the coagula would point to the same mode of formation in the two cases. I then examined microscopically the precipitate produced, first, when the oil globules were coagulated by colloidal ferric hydroxide, secondly when the precipitate was produced by the electrolysis of a sodium carbonate solution using iron electrodes, and thirdly the precipitate obtained by precipitating basic ferrous sulphate in the water. The appearance of the precipitate produced in these three cases is exactly similar, which is a further proof that the electrolytic separation of the oil is extremely closely allied in its nature to colloidal coagulation, and consists in the precipitation of a positively charged compound around the negatively charged oil globules. Further, the similarity of the coagula shows that the function of electrolysis is merely to produce the precipitation in the water of a positively charged basic ferrous salt.

"There have been various attempts made to separate the oil from the condenser water by precipitating substances therein, and the general idea of cleansing water from suspended impurities by means of flocculent precipitates is an extremely well-known mode of water purification. The principal substances used for the purification of water from suspended impurities are ferric and aluminium hydroxides and other voluminous precipitates. . . . .

"The essential function of an electrolytic oil separator is to provide a simple and automatic means for precipitating in the water a basic ferrous salt, and in place of it we may use various filtering media or precipitate various flocculent precipitates in the solution. These remarks apply almost equally well to the separation of all suspensions, since practically all suspended particles are negatively charged, and will, therefore, behave in an exactly similar way to the oil globules. I have made some determinations in order to find out exactly how much of the oil is removed by this process. Since the oil in the emulsion rises gradually to the top of the liquid and adheres so strongly to the other oil particles on the surface that these visible agglomerates cannot be completely broken up by shaking, some other substance must be used as a standard of turbidity. For this purpose soap solutions of various concentrations were used.

"To compare the turbidity of two given liquids, such as an oil emulsion and soap solution, by means of transmitted light is very difficult, since evidently the precision of this method decreases as the percentage of the light cut off decreases. To overcome this trouble, and to get a quicker way of determining the content of oil, a simplified form of Richard's 'Nepthelometer' was employed. In the simplified form used for these experiments two test tubes are taken, the rims being cut off so that black paper tubes can be readily slid up and down the tubes. The ends of these tubes are covered with black paper to cut off any reflection in the curved ends. On looking down the black tubes into the liquid only the light reflected by the particles in the liquid is seen. The relative turbidity is then obtained by sliding up and down the black tubes until the amount of light reflected or the apparent turbidity is the same in both tubes. Then the amount of oil in each tube is, of course, inversely proportional to the length of tube exposed to the light.

"Using this apparatus, the efficiency of separation in the Davis-Perrett appa-

ratus was found to be over 98.5 per cent., the actual amount of oil still contained in the water after treatment being less than one part in a million. This amount of oil is so small that it is impossible to detect it by direct comparison with distilled water, and the turbidity can only be detected by means of a Nepthelometer. I cannot give accurate figures for the separation of oil by means of filtering materials, though in the case of coke it would appear to be over 95 per cent., and a similar or higher efficiency for filtration through red ochre.

"As to the cost of operation, the two principal items are the electrical energy consumed and the soda or other substance added to the water. Using an emulsion of pure oil and pure water containing 1 part of oil and 20,000 of water, which is about the maximum content of oil ordinarily obtained in condenser water, I found that the minimum amount of electricity required was about 135 coulombs per gallon of water treated. This result was obtained on a small laboratory apparatus, but is, I think, sufficient to show the order of magnitude of the electrical energy required and to base one or two calculations as regards cost of operation.

"The following calculations were based on the assumption that bipolar electrodes are used, and that the current efficiency is 100 per cent. Where iron electrodes are used in a very dilute sodium carbonate solution the decomposition voltage is about 1.50 volts, but I found that efficient bipolar action can be readily obtained by making the holes in the plate or the spaces round the plate small. Using 50 iron plates, the current required for treating 1,000 gallons of feed water per hour will be 1.75 amperes, and at 230 volts the watt-hours will be 227—a ridiculously small amount. With electricity at 2d. per unit the cost of the current works out at ½d. per 1,000 gallons of feed water treated. The next item is the sodium carbonate added to raise the conductivity to the necessary amount. To each 1,000 gallons of feed water 1.5 pounds of sodium carbonate must be added. With carbonate at £5 10s. per ton, the cost per 1,000 gallons is then a fraction less than 1d. The last item is the renewal of the iron plates. As these plates are used as bipolar electrodes, they should not be used after their thickness is much less than ¼ inch. However, reckoning on a 12-hour day, the iron plates should be renewed every two years, so the cost of renewal need not be considered. These figures are based on the minimum amount of electricity and sodium carbonate, but it is evident that the cost is so slight that these amounts may be very considerably exceeded without making the cost prohibitive. Except for the addition of the sodium carbonate solution, the apparatus requires no attention, for a self-flushing filter which will cleanse itself periodically is usually installed.

"The apparatus may be further simplified by adding tap water instead of sodium carbonate solution, the calcium and other salts acting as the electrolytes. The amount of salts introduced will be less than that contained in ordinary hard water. Thus, supposing the water added contained only calcium carbonate, sufficient would have to be added for the condenser water to contain 9 grains per gallon. Chloride solutions may be added in place of carbonate, and hence sea water may be used if desired.

"There is a further consideration, and that is, What will be the effect on the boilers of a solution of a carbonate or other salt which has been electrolysed? Since alkali is always formed at the cathode, and the precipitate formed is not pure hydroxide, but a basic salt, there will always be a slight excess of alkali in the water introduced into the boilers. Since the water is very faintly alkaline, and since the corrosion of iron is proportional to the content of hydrogen in the water, the amount of corrosion will probably be less than is the case in ordinary pure water. Further, the apparatus appears to have a considerable field for use, not only in connection with the separation of oil from condenser water, for which it was primarily designed, but also for the treatment of other suspensions and colloidal solutions, and its cost in many cases would not appear to be prohibitive."

# THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE"

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

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NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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## CIVIL ENGINEERING.

### BRIDGES.

**Arches.**

The Arch Principle in Engineering and Esthetic Aspects, and Its Application to Long Spans. Discussion of the paper on this subject by C. R. Grimm. 4500 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19036 F.

Exact Solution of a Five-Centered Arch. Harley G. Overholt. Mathematical. 200 w. Minn Engr—Nov., 1910. No. 19758 C.

**Design.**

Traction Stresses. S. Blumenthal. A study of these stresses as related to the design of bridge piers, trestle towers, and similar structures. 1000 w. Can Soc of Civ Engrs—Oct., 1910. No. 19016 N.

**Erection.**

Erecting a Bridge on a High Falsework Tower. Illustrated description of work in Switzerland, in erecting the longest highest span in that country. 2000 w. Eng Rec—Dec. 17, 1910. No. 19383.

*We supply copies of these articles. See page 839.*

**Lift Bridges.**

The Wattrelos Hydraulic Lift Bridge (Note sur le Pont Levant Hydraulique de Wattrelos). M. Wibratte. Describes a bridge over the Roubaix Canal which carries heavy vehicular and street-car traffic. Ills. 3200 w. Ann d Ponts et Chaussées —1910-V. No. 19602 E + F.

**Masonry.**

See Viaducts, under BRIDGES.

**Piers.**

See Dikes, under WATERWAYS AND HARBORS.

**Reconstruction.**

Construction and Reconstruction of the Coteau Bridge. Illustrates and describes the building and rebuilding of a steel bridge on the Grand Trunk Ry., across the St. Lawrence River, under difficult and dangerous conditions. 2500 w. Eng Rec—Dec. 3, 1910. No. 19077.

**Reinforced Concrete.**

Reinforced Concrete Work on the Northern Pacific. Illustrates and describes the construction of trestles and bridges, explaining their advantages. 1000 w. Ry Age Gaz—Dec. 16, 1910. No. 19376.

The Meadow St. Reinforced-Concrete Arch Bridge, Pittsburg, Pa. N. S. Sprague. Explains conditions that led to the use of this material, and gives an illustrated detailed description of the bridge and its construction. 4500 w. Eng News—Dec. 1, 1910. No. 19050.

The New Charles River Bridge, Boston Elevated Railway. Illustrated detailed description of a reinforced-concrete 5-arch structure, between Boston and Cambridge, and the methods of construction. 2500 w. Eng Rec—Dec. 17, 1910. No. 19380.

See also Viaducts, under BRIDGES.

**Steel.**

Steel Arched Ribs for Railway Bridges. Considers the cost of the superstructure of a steel arch bridge, and compares the cost of the abutments with those required for a girder bridge. 2500 w. Engr, Lond —Dec. 9, 1910. No. 19447 A.

The Calvin Street Bridge, Buffalo. Illustrates and describes details of a four-span plate-girder bridge carrying four tracks of the N. Y. C. & H. R. R. R. 600 w. Eng Rec—Dec. 24, 1910. No. 19565.

The St. Louis Municipal Bridge Superstructure. Illustrated description of a bridge having three 668-ft. spans. The pin-connected trusses are of nickel steel, and the floor system and bracing will be of carbon steel. 2000 w. Eng Rec—Dec. 3, 1910. No. 19084.

Berlin's Municipal Bridges (Vom städtischen Brückenbau in Berlin). Describes the Swinemünder cantilever highway bridge. Ills. 2000 w. Deutsche Bau—Nov. 16, 1910. No. 19690 B.

The New Bridge over the Drau at Marburg (Der Neubau der Draubrücke in Marburg). Describes a three-span steel arch structure with masonry approaches. Ills. 3600 w. Oest Wochenschr f d Oeffent Baudienst—Nov. 5, 1910. No. 19812 D.

The Kaiser Franz Josef Bridge over the Elbe at Leitmeritz (Die Eröffnung der Kaiser Franz Josef-Brücke über die Elbe in Leitmeritz). The bridge has eight steel truss spans. Ills. 2800 w. Oest Wochenschr f d Oeffent Baudienst—Nov. 12, 1910. No. 19813 D.

The Construction of the Bridge over the Danube for the Second Line of the Northwest Railway, Vienna (Ueber den Bau der Donaubrücke für das Zweite Gleis der Nordwestbahn in Wien). Josef Walter. Describes the duplication of an existing steel structure alongside the latter. Ills. 2800 w. Zeitschr d Oest Ing u Arch Ver—Nov. 11, 1910. No. 19810 D.

See also Erection, under BRIDGES.

**Testing.**

See Bridge Testing, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

**Viaducts.**

The Baltimore & Ohio Viaduct Over Brandywine Creek. Illustrated description of a double-track stone viaduct at Wilmington, Del. 2000 w. Eng Rec—Dec. 17, 1910. No. 19382.

The Asylum Ave. Concrete Viaduct, Knoxville, Tenn. L. W. Frierson. Illustrates and describes a reinforced concrete flat girder bridge resting on braced column bents. 1000 w. Eng News—Dec. 15, 1910. No. 19354.

The St. Jean La Riviere Viaduct. Illustrated description of a reinforced-concrete arch with a span of 149.2 ft. on centers, and the method of erection. 1500 w. Eng Rec—Dec. 3, 1910. No. 19083.

The Sitter Viaduct, near St. Gall, Switzerland (Viaduc sur la Sitter, à Kubel, près de Saint-Gall, Suisse). Brief description of the design and construction of this very high structure of masonry with one steel span. Ills. 4200 w. Génie Civil—Nov. 26, 1910. No. 19644 D.

The Horst-Emscher Tramway Viaduct (Strassenbahn - Viaduct bei Horst-Emscher). Herr Färber. Describes an important reinforced-concrete structure with one long arch span. Ills. Serial. 1st part. 1400 w. Deutsche Bau—Nov. 2, 1910. No. 19688 B.

## CONSTRUCTION.

**Boring.**

Diamond-Drill Borings for a Dam on the Clackamas River (Oregon). Condensed from a paper by V. J. Hampton, in *Mines and Quarries*. Illustrated description of borings made, and information concerning the progress and methods of work. 1700 w. Eng News—Dec. 22, 1910. No. 19484.

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**Columns.**

Eccentrically-Loaded Columns. Walter Elsworthy Lilly. Describes tests made, comparing the values with those derived from formulae applicable to the cases considered. Discusses principles, and gives reasons for the choice of formulae adopted. Ills. 4500 w. Inst of Civ Engrs—No. 3849. No. 19472 N.

**Concrete.**

Studies in Economic Construction. An illustrated outline of research work in building construction, with particular reference to the use of concrete in model dwellings. 5000 w. Cement Age—Dec., 1910. No. 19521 C.

How to Put in Concrete Work in Winter Months. Ernest McCullough. Suggestions for obtaining satisfactory results in freezing weather. 1500 w. Min Wld—Dec. 24, 1910. No. 19561.

Conveying and Depositing Concrete by Gravity Chutes. Illustrated description of the plant and its operation. 2500 w. Eng News—Dec. 8, 1910. No. 19240.

Large Portable Plant for Crushing, Mixing, and Placing Concrete on Catskill Aqueduct. Illustrated description of plant and methods. 2500 w. Engng Con—Dec. 7, 1910. No. 19220.

Methods and Cost of Concrete Work at the Gatun Locks of the Panama Canal. Plan and description of the construction plant and methods. Ills. 2000 w. Engng Con—Dec. 7, 1910. No. 19221.

The Cost of Concrete on the Panama Canal Locks. Gives a table of construction expenditures on the Panama Canal to Sept. 30, 1910, and a table of unit costs of concrete. 1200 w. Eng Rec—Dec. 3, 1910. No. 19073.

See also Fishery Harbors, under WATERWAYS AND HARBORS.

**Contractors' Plants.**

See Concrete, under CONSTRUCTION.

**Excavation.**

Excavation Methods, Fourth Avenue Subway, Brooklyn. Illustrates and describes four methods used by different contractors, almost wholly in earth and sand, with occasional boulders but no solid rock. 1800 w. Eng Rec—Dec. 3, 1910. No. 19080.

**Failures.**

The Collapse of the Reinforced-Concrete Henke Building, Cleveland, Ohio. Illustrates and describes the failure of a 4-story building about completed. 800 w. Eng News—Dec. 8, 1910. No. 19241.

**Fireproof.**

See Gypsum, and Heat Changes, under MATERIALS OF CONSTRUCTION.

**Floors.**

The Calculation of Plates, Supported by Four Columns. L. J. Mensch. Read before the Nat. Assn. of Cement Users. Compares the theory of plates supported by four columns with the theory, practice, and tests of round and square plates. Mathematical. 1400 w. Engng-Con—Dec. 28, 1910. No. 19783.

The Basis of Design for Flat Concrete Floor Slabs. A discussion by Arthur R. Lord before the Nat. Assn. of Cement Users. States evidence of tests made applicable to a consideration of the basis of design for reinforced-concrete floor slabs. 3000 w. Eng Rec—Dec. 24, 1910. No. 19566.

A Test of a Flat Slab Floor in a Reinforced-Concrete Building. Arthur R. Lord. Read before the Nat. Assn. of Cement Users. Describes a test for actual stresses. Ills. 4000 w. Eng News—Dec. 22, 1910. No. 19486.

**Foundations.**

Grouting Natural Soils for Bridge and Building Foundations. W. D'Rohan. Discusses the value of the method of F. A. Lart for solidifying the natural ground under foundations. 1000 w. Engng-Con—Dec. 21, 1910. No. 19476.

The Windsor Station Foundations, Montreal. Describes method of building about 300 concrete piers through soil of varied character. Ills. 1200 w. Eng Rec—Dec. 3, 1910. No. 19088.

Foundations for the Municipal Building, New York. Maurice Deutsch. Illustrated description of interesting and difficult foundations for a 25-story building, with a tower having 15 additional stories. 4500 w. Sch of Mines Qr—Nov., 1910. No. 19733 D.

Concrete Pile Foundations, with Reference to the Simplex Method of Constructing the Same. Alex. Melville. Brief review of the various methods of constructing pile foundations, with description of the "Simplex" system and its use. Ills. 5000 w. Inst of Engrs & Shipbldrs in Scotland—Nov. 23, 1909. No. 19770 N.

The Substructure of the Bankers Trust Company's Building. The foundations for a 43-story building in New York, with four floors below the street level, are illustrated and described. 2500 w. Eng Rec—Dec. 10, 1910. No. 19277.

**Oil Reservoirs.**

Largest Concrete Oil Reservoirs in the World. Hamilton M. Wright. Illustrations of reservoirs at Tank Farm, California, with brief description. 700 w. Sci Am—Dec. 10, 1910. No. 19246.

**Piling.**

Sheet Piling. Ewing Matheson. Describes some early applications. Ills. 1800 w. Cassier's Mag—Dec., 1910. No. 19542 B.

Practical Notes on Making and Driving Reinforced Concrete Piles. Vere Sussex Hyde. Practical directions for the work. 2500 w. Prac Engr—Nov. 25, 1910. No. 19188 A.

Reinforced Concrete Pile. Edward Mohun. Illustrated description of the

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method, invented by the author, of reinforcing molded concrete piles by the use of angles in connection with expanded metal. 1000 w. Can Engr—Dec. 1, 1910. No. 19152.

**Reclamation.**

Reclamation of the Southern Louisiana Wet Prairie Lands. A. D. Morehouse. An illustrated article based on reports to the chief of drainage investigations. Gives information concerning the development of these lands, now in progress. Ills. 8000 w. U S Dept of Agri—Reprint from Report of June 30, 1909. No. 19762 N.

**Reinforced Concrete.**

Concrete Reinforcement (Le Béton de Ciment armé). C. Codron. A critical analysis of J. Toupet's paper before the Engineers Society of Western Pennsylvania. Ills. Serial. 1st part. 2500 w. Tech Mod—Nov., 1910. No. 19618 D.

Flat Slabs Between Iron Beams (Flachgewölbe und ebene Platten zwischen Eisenträgern). R. Saliger. Discusses results of tests on reinforced concrete slabs. Ills. 2700 w. Zeitschr d Oest Ing u Arch Ver—Nov. 25, 1910. No. 19811 D.

The Use of Concrete for the Bush Terminal Development. A. D. Mellor. Illustrated description of the use of reinforced-concrete in the Bush Terminal at South Brooklyn, for the solving of the freight problem. 2000 w. Cement Age—Dec., 1910. No. 19522 C.

Grandstand and Grounds of the Cleveland Baseball Club. Plan and description of a new installation. All the structures are of reinforced-concrete and structural steel. 1600 w. Eng Rec—Dec. 17, 1910. No. 19387.

Reinforced Concrete Car House, Dayton, Ohio. J. C. Lathrop. Illustrated description of the general plan of the property of the People's Railway Co., and the construction of the car house. 2500 w. Elec Ry Jour—Dec. 31, 1910. No. 19781.

Design of Two Large Reinforced Concrete Buildings. M. E. Thomas. Illustrated description of new shops for the General Electric Co., at Schenectady, N. Y. 2500 w. Eng Rec—Dec. 10, 1910. No. 19270.

A Large Concrete Coal Breaker and Washery Building. Illustrated description of an interesting structure recently completed at Taylor, Pa., near Scranton. 2500 w. Eng Rec—Dec. 3, 1910. No. 19079.

The Construction in Reinforced Concrete of the Basilea Municipal Theatre (Le Costruzioni in Cemento Armato del Teatro Municipale di Basilea). A brief description of the design and erection. Ills. 2000 w. Il Cemento—Nov. 15, 1910. No. 19657 D.

Two Monumental Reinforced-Concrete Halls (Zwei monumentale Hallenbauten in Eisenbeton). H. Spangenberg. Describes the design and construction of two large concrete buildings. Ills. Serial. 1st part. 2500 w. Schweiz Bau—Nov. 19, 1910. No. 19694 B.

See also Failures, Floors, and Oil Reservoirs, under CONSTRUCTION; Tanks, under WATER SUPPLY; Piers, under WATERWAYS AND HARBORS; and Boiler Settings, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

**Retaining Walls.**

The Design of Retaining Walls. Edward Godfrey. A critical discussion of designs and methods of determining stability. Ills. 4500 w. Engng-Con—Dec. 21, 1910. No. 19477.

Enlargement of the Track Space at the Saint Lazare Station, Paris (Elargissement du Goulot de la Gare Saint-Lazare). Charles Rabut. Describes some features of the retaining-wall construction. Ills. 1800 w. Génie Civil—Nov. 5, 1910. No. 19639 D.

**Steel.**

Stanchions Carrying Eccentric Loads. Ernest G. Beck. A mathematical solution of the problem of determining the stresses induced. 1200 w. Engr, Lond—Dec. 2, 1910. No. 19334 A.

**Subways.**

Construction of a Portion of the Fourth Avenue Subway, Brooklyn. The section from 10th St. to 27th St. is illustrated and described, with the scheme of the construction work. 3000 w. Eng Rec—Dec. 17, 1910. No. 19384.

**Tunnels.**

The Hudson River Tunnels of the Hudson and Manhattan Railroad Company. Charles Mattathias Jacobs. History and illustrated description, with abstract of discussion. 36500 w. Inst of Civ Engrs —No. 3859. No. 17474 N.

See also same title, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

**Underpinning.**

Underpinning the Manhasset Building, New York. Illustrated description of the underpinning necessary in changing the first floor of a 12-story apartment house into stores. 2000 w. Eng Rec—Dec. 10, 1910. No. 19275.

**Waterproofing.**

Waterproofing the New Ulm Concrete Reservoir. A 1,000,000-gal. reservoir in Minnesota is described; its troubles with leaks, and their repair. Ills. 1000 w. Eng Rec—Dec. 17, 1910. No. 19385.

## MATERIALS OF CONSTRUCTION.

**Brick.**

The Development of English Brickwork. H. Franklyn Murrell. Read before the Inst. of Bldrs. Illustrates and describes some beautiful work executed in this material. 2000 w. Archt, Lond—Dec. 2, 1910. Serial. 1st part. No. 19308 A.

*We supply copies of these articles. See page 839.*

**Cement.**

Puzzolan-Portland Cement; A Suggestion for an Improved Hydraulic Cement. Edward Durfee. Information concerning a means of obtaining a cement that will secure mortars permanently waterproof and of better color for architectural uses. 3000 w. Eng News—Dec. 1, 1910. No. 19054.

**Concrete.**

Some Thermal Properties of Concrete. Charles L. Norton. Read before the Nat. Assn. of Cement Users. Discusses results of a study of various physical properties of concrete over a wide range of temperatures. 3000 w. Eng Rec—Dec. 24, 1910. No. 19570.

Concrete and Concrete Tests. Alfred E. Corbett. Read before the Manchester Soc. of Archts. A report of tests made to obtain an impervious concrete with a crushing strength of 154 tons per sq. ft. when 28 days old. 6000 w. Jour Roy Inst of British Archts—Nov. 12, 1910. No. 19337 B.

**Concrete Blocks.**

Density and Strength of Concrete Blocks Cast in Sand Molds. R. C. Carpenter. Gives results and describes tests made by pouring the same mixture into different kinds of molds. Those made in sand molds showed great superiority. 1200 w. Sib Jour of Engng—Nov., 1910. No. 19022 C.

**Gypsum.**

Gypsum as a Fireproofing Material. From a pamphlet by H. G. Perring. Information regarding the fire-resisting qualities of gypsum. 1800 w. Eng Rec—Dec. 3, 1910. No. 19087.

**Heat Changes.**

Heat Changes in Structural Materials. James E. Howard. Extracts from a paper read before the Nat. Assn. of Mutual Ins. Co.'s. Discusses the relation of temperature to tensile and compressive strength. 2000 w. Ir Age—Dec. 1, 1910. No. 19041.

**Mortars.**

The Diversity of the Results Obtained in Tests of Cement Mortars Using Sands of Different Compositions (Sulle Differenze dei Risultati Ottenuti nelle Prove dei Sementi Adoperando Sabbie di Differenti Nature). Quotes test results to show the importance of the quality of the sand used in cement mortars. 2700 w. Il Cemento —Nov. 30, 1910. No. 19660 D.

See Cement Testing, under MEASUREMENT.

**Reinforced Concrete.**

Reinforced Concrete. C. A. P. Turner. Discusses the materials that enter into the combination, the methods of inspecting and selecting them, and their suitability, the problems in the combination of concrete and steel in building construction, etc. 4500 w. Minn Engr—Nov., 1910. No. 19757 C.

An Investigation of the Corrosion of Iron Imbedded in Concrete. Guy F. Shaffer. An illustrated study of the action of stray currents. 2500 w. Harvard Engng Jour—Nov., 1910. No. 19754 D.

Further Tests on the Effect of Electric Currents Upon Concrete and Steel. U. James Nicholas. An illustrated report of research work carried out at the Univ. of Melbourne with the object of studying the effect of currents on reinforced concrete. 3500 w. Eng News—Dec. 1, 1910. No. 19052.

**Timber.**

Some Tests of Old Timber. C. P. Buchanan. Shows, as a result of tests, that timber 25 years old is stronger than new stock. 1000 w. Eng News—Dec. 8, 1910. No. 19236.

**Timber Preservation.**

Timber Preservation, Its Development and Present Scope. Walter Buehler. Considers Burnettizing and creosoting as the two basic processes. 3500 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19034 F.

The Preservation of Structural Timbers from Decay. C. P. Winslow. Aims to point out the principles which determine the success of any treatment, discussing the preservatives and processes now in use. Ills. 14500 w. Pro Engrs' Soc of W Penn—Dec., 1910. No. 19547 D.

Wood Preservation. A. L. Kuehn. Abstract of paper read before the Cent. Elec. Ry. Assn. Considers the causes of decay, preservatives and methods of preservation used. 2500 w. Elec Ry Jour—Dec. 3, 1910. No. 19148.

The Preservation of Timber (Die Konservierung des Holzes). Th. Wolff. Discusses the preservative treatment of wood for the purposes of marine and naval construction. 5000 w. Schiffbau—Nov. 9, 1910. No. 19686 D.

## MEASUREMENT.

**Cement Testing.**

Acceptance Tests for Cement Materials (Intorno all'Assaggio ed al Collaudo dei Materiali Cementizi e delle Malte). Discusses the composition and testing of cement mortars. Serial. 1st part. 2300 w. Industria—Nov. 6, 1910. No. 19655 D.

**Hydrographic Surveying.**

Wire Drag Work of the United States Coast and Geodetic Survey. Illustrates and describes a method of hydrographic surveying which will verify least depths over an entire area. 2500 w. Eng News —Dec. 1, 1910. No. 19051.

**Surveying.**

Deep Tunnel Alignment from Shafts. Herbert M. Hale. Explains methods of underground surveying in connection with the work of the Catskill water supply for New York City. Ills. 3000 w. Harvard Engng Jour—Nov., 1910. No. 19755 D.

## MUNICIPAL.

**Budget Exhibit.**

An Influence for Efficiency in Municipal Administration. Herbert T. Wade. An illustrated discussion of the New York Budget Exhibit of 1910, and its value. 4500 w. Engineering Magazine—Jan., 1911. No. 19747 B.

**City Planning.**

The Planning of an Industrial Suburb. E. A. Slater. Illustrated description of a design, the distinguishing characteristic being a central rectangular open space for games, walks, etc. 2000 w. Surveyor—Dec. 2, 1910. No. 19319 A.

**Industrial Wastes.**

The Disposal of Trade Wastes. George A. Johnson. Portions of a paper read before the N. J. San. Assn. General discussion. 1500 w. Eng News—Dec. 8, 1910. No. 19242.

**Organization.**

Boston's New Department of Public Works Under One Engineering Head. Benjamin Baker. Describes a new plan of organization devised by L. K. Rourke. Also editorial. 4000 w. Eng News—Dec. 22, 1910. No. 19485.

**Pavements.**

A New Paving Material (Un Nuovo Materiale da Pavimentazione). A description of "Rostolit" artificial stone. Ills. 2000 w. Il Cemento—Nov. 15, 1910. No. 19659 D.

Wood Block Pavements. Synopsis of information collected by the Am. Soc. of Munic. Imp. 3000 w. Munic Jour of Engr—Dec. 7, 1910. No. 19209.

I. Specifications for Asphalt Pavements. E. M. Purdue. II. Proposed Specifications for Sheet Asphalt Pavements. F. P. Smith. Also editorial. Objections to some of the principles on which specifications are based. 6000 w. Munic Engng—Dec., 1910. No. 19731 C.

**Refuse Destructors.**

Easton Garbage Incinerator. John McNeal. Illustrated description of a 35-ton plant, with cost of operation. 1500 w. Munic Jour & Engr—Dec. 28, 1910. No. 19780.

Combined Destructor and Electricity Works. E. Kilburn Scott. Gives a summary of data collected in regard to such plants and their management. 1500 w. Elec Rev, Lond—Dec. 9, 1910. No. 19424 A.

**Road Rollers.**

Recent Types of Road Rollers (Ueber Strassenwalzen neuerer Konstruktion). Karl Breitenfelder. Describes both steam and oil-engine rollers. Ills. 4600 w. Oest Wochenschr f d Oeffent Baudienst—Nov. 26, 1910. No. 19815 D.

**Roads.**

The Working of the "Road Development Act, 1909." Reginald Brown. Discusses needed improvements in highways and how they are to be accomplished. Ills. 7000 w. Soc of Engrs—Dec. 5, 1910. No. 19431 N.

The United States Office of Public Roads. Explains the purpose and scope of the work. Ills. 4000 w. Eng Rec—Dec. 17, 1910. No. 19389.

State Aid in Road Building. Logan Waller Page. Read before the Am. Road Bldrs. Assn. Reviews the history of road building in the United States and explains the principles which the author considers should govern the framing of a State highway law. 4000 w. Eng Rec—Dec. 24, 1910. No. 19567.

Road Construction in the United States. W. W. Crosby. Read at the Nat. Good Roads convention. Discusses the practice of the modern highway engineer. 3500 w. Com Veh—Nov. & Dec., 1910. Serial. 2 parts. No. 19166 each C.

Notes on the Construction of Gravel Roads. From the Third Biennial Report of the Mich. Highway Dept. Deals with grading, tools required, graveling, rolling, etc. 2500 w. Engng-Con—Dec. 28, 1910. No. 19784.

Top Soil Roads in Clarke County, Georgia. C. M. Strahan. Explains the method of constructing these roads, their low cost and cheap maintenance. 2000 w. Munic Engng—Dec., 1910. No. 19732 C.

Two Years' Experience in Dust Suppression on New Jersey Roads. James Owen. Read before the State San. Assn. of N. J. Gives the experience in one locality in the effort to attain a dustless road. 3000 w. Eng Rec—Dec. 10, 1910. No. 19274.

Free Carbon in Tar. Joseph Race. Gives information and investigations of interest to road engineers and makers of tar-macadam. 2500 w. Surveyor—Nov. 25, 1910. No. 19185 A.

Surface Treatment for Dust Laying. Suggestions as to the most effective means of dealing with this problem. 2000 w. Surveyor—Nov. 25, 1910. No. 19186 A.

The Dust Problem on Roads (Routes et Pouissière). Paul Etier. Read at the Second Road Congress. A report on conditions in Switzerland, the first part dealing with macadam roads. Ills. Serial. 1st part. 2500 w. Bul Tech d l Suisse Romande—Nov. 25, 1910. No. 19636 D.

**Sewage Disposal.**

Sewage Disposal in Europe. Rudolph Hering. Presented to the Am. Inst. of Chem. Engrs. A study of the methods now used. 4000 w. Eng Rec—Dec. 17, 1910. No. 19388.

The Sludge Problem. W. C. Easdale. Read before the Assn. of Mgrs. of Sewage Disposal Works. Presents arguments in support of a new method of disposing of, or preventing the formation of sludge. 3300 w. Surveyor—Dec. 9, 1910. No. 19432 A.

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A New Method of Handling Sewage Sludge. Dr. Karl Imhoff and Charles Saville. Illustrated detailed account of methods used in Germany and now to be introduced extensively at Atlanta, Ga. 5000 w. Eng Rec—Dec. 10, 1910. No. 19276.

I. Birmingham Sewage Disposal Works. John Duncan Watson. II. Salisbury Drainage. William James Eames Birnie. Descriptive papers, with abstract of the discussion. Ills. 14000 w. Inst of Civ Engrs. No. 3865 and No. 3858. No. 19475 N.

A German Sanitary District and the Imhoff Sewage Purification Tank. Charles Saville. With introduction by Rudolph Hering. Also editorial. Description and general information concerning this German tank, said to make possible the purification of sewage without offensive odor. Ills. 7000 w. Eng News—Dec. 1, 1910. No. 19058.

The Department of the Seine and the Bacterial Purification of Sewage (Le Département de la Seine et l'Epuration bactérienne des Eaux d'Egout). M. Mahieu. Discusses the problem of sewage disposal in Paris and describes the recent projects for sewage purification plants and the new works already executed. Ills. 14700 w. Ann d Ponts et Chaussées—1910-V. No. 19603 E. + F.

**Sewers.**

Hartford East Side Intercepting Sewer. Illustrated description of a sewer under construction to prevent floods and purify the harbor. 4500 w. Munic Jour & Engr —Dec. 14, 1910. No. 19343.

Intercepting Sewers and Outfall at New Bedford. Data regarding conditions along the city's water front, and the means to be adopted to better them by improving the sewerage system. Ills. 1200 w. Eng Rec —Dec. 17, 1910. No. 19381.

The Jones Falls Covered Conduits and Boulevard, Baltimore. Plans and description of a triple-barrel reinforced concrete conduit supporting a roadway and sidewalks to be constructed. 1200 w. Eng Rec —Dec. 3, 1910. No. 19082.

The North Trunk Sewer in Seattle. Explains conditions and outlines the work in progress, giving an illustrated detailed description of the North Trunk sewer. 3000 w. Eng Rec—Dec. 10, 1910. No. 19273.

**Snow Plows.**

Snow Plows for City Use. Illustrates and describes various types to meet different requirements. 3000 w. Munic Jour & Engr—Dec. 7, 1910. No. 19208.

**Snow Removal.**

Snow Removal in New York. Walter G. Turini. Describes the methods employed, with special reference to the work of 1909-10. 1800 w. Munic Jour & Engr—Dec. 21, 1910. No. 19508.

**Street Cleaning.**

The Necessity for a Technical Organization in Street Cleaning (Della Necessita di un'Organizzazione Tecnica dei Servizi della Nettezza Urbana). Riccardo Badoglio. Discusses the essentially engineering nature of the street-cleaning problem. 8400 w. Ann d Soc d Ing e d Arch Ital—Oct. 1, 1910. No. 19647 F.

## WATER SUPPLY.

**Dams.**

Design and Computations for a Cellular Reinforced Concrete Dam. George J. Bancroft. Abstract of a paper read before the Colo. Sci. Soc. Describes a dam built like a honeycomb, the cells being vertical. The cells are filled with earth and rock. 3000 w. Engng Con—Dec. 14, 1910. No. 19344.

Reconstruction of Marshall Lake Dam. I. G. Harmon. Illustrated detailed description of work in Colorado, explaining conditions. 2000 w. Eng Rec—Dec. 24, 1910. No. 19569.

Movable Dams on the New York State Barge Canal. Illustrated detailed description of the type adopted, known as the bridge dam with the Boulé gates. 3000 w. Eng News—Dec. 8, 1910. No. 19231.

Repairs to the Gigny Dam on the Saône (Réparations des Avaries survenues au Barrage de Gigny sur la Saône). Henri Tavernier. Describes the repair of cracks and cavities in the concrete foundations and in the body of the dam. Ills. 2500 w. Ann d Ponts et Chaussées—1910-V. No. 19601 E + F.

See also Boring, under CONSTRUCTION.

**Filtration.**

Minneapolis Filters. J. Arthur Jensen. Describes the form of purification adopted for improving the supply from the Mississippi River. 1200 w. Minn Engr—Nov., 1910. No. 19760 C.

See also Sheffield, under WATER SUPPLY.

**Gravity Distribution.**

A Case of Water Distribution Entirely by Gravity (Un Caso Singolare di Distribuzione d'Acqua merce la Sola Energia di Gravita dell'Acqua Condotta). Elia Ovazza. Examines the case of a city very favorably located for gravity distribution, discussing the determination of the best method and apparatus to employ. Ills. 3700 w. Monit Tech—Nov. 30, 1910. No. 19654 D.

**Irrigation.**

A Few Notes on Irrigation. Boris Levitt. Brief information concerning things affecting the water supply, methods of irrigation and use, etc. 2500 w. Sch of Mines Qr—Dec., 1910. No. 19735 D.

Hydrography as an Aid to the Successful Operation of an Irrigation System. J. C. Stevens. A discussion of hydrographic

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work as conducted on the Sunnyside project of the U. S. Reclamation Service, in Washington. Map and curves. 7500 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19032 F.

The Economy of the Prevention of Conveyance Losses of Irrigation Water and the Use of Concrete for the Economical Construction of Irrigation Structures. Prof. Etcheverry. Read before the W. Can. Ir. Assn. Discusses seepage and evaporation losses, and the use of concrete. 5500 w. Can Engr—Dec. 22, 1910. No. 19558.

The Function of the State Engineer in the Arid and Semi-Arid States. Samuel H. Lea. Condensed from address at the Nat. Irrigation Cong. Deals principally with their work in relation to irrigation and public control of water. 1500 w. Eng News—Dec. 1, 1910. No. 19055.

**Pipe Flow.**

Graphic Calculation of the Flow of Water in Pipes. T. G. Bocking. Refers briefly to various formulae, and gives a graphical solution. 2500 w. Engr, Lond—Nov. 25, 1910. No. 19195 A.

**Pipe Laying.**

Laying Large Submerged Gas Mains at New York. From a paper by Colin C. Simpson, read before the Am. Gas Inst. Illustrated description of how the operations were conducted in laying mains under the Harlem River. 3000 w. Eng Rec—Dec. 3, 1910. No. 19086.

**Pipe Lines.**

The New 30-In. Cast Iron Conduit from Lake Skaneateles to Syracuse, Syracuse Water Works. M. B. Palmer. Describes a second conduit recently laid to increase the supply, and a standpipe. Ills. 5000 w. Engng-Con—Nov. 30, 1910. No. 19046.

See also Reservoirs, under WATER SUPPLY.

**Purification.**

The Purification of Public Water Supplies. T. Aird Murray. Discusses principally the methods and principles for the removal of disease-producing organisms. 3500 w. Ap Sci—Dec., 1910. No. 19724 C.

The Eliminating Effect of Chlorine Upon the Bacteria of a River Water. Leslie C. Walker. Read before the Assn. of Water Engrs. States facts ascertained during a trial to test the efficiency of the De-Clor system, which claims to remove excretal bacteria from water intended for domestic uses. Also general discussion. 7000 w. Surveyor—Dec. 16, 1910. No. 19587 A.

Water Purification Plant at Newport, R. I. Illustrated detailed description of a satisfactory plant. 2500 w. Munic Jour & Engr—Dec. 28, 1910. No. 19779.

**Reservoirs.**

Covered Service Reservoir at Ambergate. Illustrates and describes this reservoir and pipe lines of the Derwent Valley scheme. 1000 w. Engr, Lond—Dec. 16, 1910. No. 19700 A.

See also Waterproofing, under CONSTRUCTION.

**Sheffield.**

I. Notes on the Sheffield Water Supply, and Statistics Relating Thereto. Leonard Swaine Morelock Marsh. II. Statistical and Experimental Data on Filtration. William Ralph Baldwin-Wiseman. III. Abstract of discussion and correspondence on the two papers. Ills. 63000 w. Inst of Civ Engrs—No. 3795 & No. 3818. No. 19473 N.

**Sterilization.**

Sterilization of Polluted Water by Ultra-Violet Rays at Marseilles, France. From *Le Genie Civil.* Gives results of the operation of an experimental plant. 800 w. Eng News—Dec. 8, 1910. No. 19239.

The Sterilization of Large Quantities of Water by Means of Ultra-Violet Rays (La Sterilisation de Grandes Quantités d'Eau par les Rayons Ultraviolets). Max de Recklinghausen. Describes the Marseilles installation. Ills. 2500 w. Génie Civil—Nov. 5, 1910. No. 19640 D.

The Effects of Ultra-Violet Rays (Wirkungen der ultravioletten Strahlen). Erich Schneckenberg. Discusses their effect on bacteria and on various fluids and chemicals. 4200 w. Elektrotech u Maschinenbau—Nov. 20, 1910. No. 19831 D.

Sterilization of Water by Ultra-Violet Light (Industrielle Wassersterilisation mit Ultra-violettem Licht). Max von Recklinghausen. Describes the theory, the apparatus, and the results. Ills. Serial. 1st part. 2400 w. Elektrochem Zeitschr—Nov., 1910. No. 19662 D.

**Tanks.**

A Reinforced-Concrete Water Tank with Dome-Shaped Bottom. L. A. Waterbury. Illustrated description of the tank erected on the Campus of the University of Arizona, at Tucson. 1500 w. Eng News—Dec. 15, 1910. No. 19359.

See also Oil Reservoirs, under CONSTRUCTION.

**Vancouver, B. C.**

A New Water Supply for the City of Vancouver, B. C., H. M. Burwell. An illustrated description of the new system from Seymour Creek, made necessary by increase in population. 3500 w. Can Soc of Civ Engrs—Dec. 8, 1910. No. 19526 N.

**Water Towers.**

A Tall Concrete Block Water Tower Near Brussels. From *Le Génie Civil.* Illustration, with brief description. 1200 w. Eng Rec—Dec. 10, 1910. No. 19272.

See also Pipe Lines, under WATER SUPPLY.

**Water-Works Management.**

Some Comments on Water Works Management. Leonard Metcalf. Read before the Penn. W-Wks. Assn. Examines statistics of the operation of public

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water-works in the United States. 3000 w. Eng Rec—Dec. 24, 1910. No. 19571.

**Wells.**

Methods and Cost of Sinking and Lining a Dug Well on Long Island. J. L. Ingle, Jr. Detailed description of the work. 2000 w. Engng-Con—Dec. 7, 1910. No. 19222.

See also Boring, under MINING AND METALLURGY, MINING.

## WATERWAYS AND HARBORS.

**Breakwaters.**

The Construction of the Djidjelli Breakwater (Note sur la Construction de la Jetée de Djidjelli). M. Daujon. A description of the design and construction of the new works at this Algerian port. Ills. 10500 w. Ann d Ponts et Chaussées—1910-V. No. 19600 E + F.

**Canal Gates.**

Emergency Gates on the Illinois and Mississippi Canal. Illustrated description prepared from a paper by Maj. C. S. Riche, describing gates built on the Hennepin Canal. 1500 w. Eng News—Dec. 15, 1910. No. 19363.

**Canals.**

The History and Economic Value of Canals, with Special Reference to the Cape Cod Canal. Com. J. W. Miller. Historical review of canals in the United States, with description of the Cape Cod Canal. Discussion. Ills. 4500 w. Soc of Nav Archts & Marine Engrs, No. 3—Nov. 17, 1910. No. 19462 N.

Progress in the Canalization of the Moldau and the Elbe in Bohemia during 1909 (Kommission für die Kanalisierung des Moldau- und Elbeflusses in Böhmen, Tätigkeit im Jahre 1909). Brief review of the projects, with report of progress. Ills. 4200 w. Oest Wochenschr f d Oeffent Baudienst—Nov. 19, 1910. No. 19814 D.

**Danube.**

The Danube in Lower Austria (Le Danube dans la Basse Autriche). M. Armand. Describes the regimen of the river and the means of regulation adopted. Ills. 9800 w. Ann de Ponts et Chaussées—1910-V. No. 19604 E + F.

**Dikes.**

Permeable Dike Construction for Protecting a Bridge Substructure, Chicago, Milwaukee & St. Paul Ry. Illustrates and describes work at Mobridge, S. D., for the protection of a bridge across the Missouri River. 1200 w. Engng-Con—Dec. 7, 1910. No. 19223.

**Dry Docks.**

Floating Dry Docks in the United States; Relative Value of Wood and Steel for Their Construction. William T. Donnelly. Compares these materials, and the methods for their care and preservation. Ills. 2500 w. Soc Nav Archts & Marine Engrs, No. 5—Nov. 17, 1910. No. 19464 N.

**Fishery Harbors.**

The Fishery Harbors of Scotland. John Taylor. Brief review of the history of the industry, with illustrated detailed description of a fine example of minor harbor construction. Especially interesting because of the extensive use of cement concrete in sea water. 11000 w. Eng News—Dec. 22, 1910. No. 19482.

**Floods.**

Forests and Their Influence on Floods (La Forêt et les Inondations). Paul Buffault. Reviews the literature of the subject, and gives the author's own views. 5200 w. Rev Gen d Sci—Nov. 15, 1910. No. 19613 D.

**Harbor Bars.**

Notes on the Bar Harbors at the Entrances to Coos Bay and Umpqua and Siuslaw Rivers, Oregon. Morton L. Tower. A study of this coast, showing that flood-tidal currents are an important factor in causing troublesome shoals at harbor entrances. Maps. 4000 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19033 F.

**Harbors.**

River and Harbor Improvements and the Corps of Engineers. W. H. Bixby. Extracts from an address before the Nat. Rivers & Harbors Congress. 4000 w. Eng Rec—Dec. 24, 1910. No. 19564.

Improvements to the Port of Asuncion on the Paraguay River (Mededeelingen betreffende de Verbetering van de Rivierhaven te Asuncion en van de Paso de Tacumbu, Paraguay). J. F. Ligtenberg. Illustrated description of the harbor works and the regulation of the river. 9600 w. De Ingenieur—Nov. 12, 1910. No. 19844 D.

**Hudson River.**

The Character of the Hudson Gorge at New York City. G. S. Rogers. A study of the geology of the river bed, and of facts brought out by recent engineering works. Ills. 6000 w. Sch of Mines Qr—Nov., 1910. No. 19734 D.

**Lock Gates.**

Renewing Lock Gates on the Kanawha River. Thomas E. Jeffries. Illustrates and describes the method adopted and found satisfactory. 700 w. Eng Rec—Dec. 24, 1910. No. 19568.

The New Canal Gate at Sault Ste. Marie. Illustrates and describes the largest wooden gates thus far constructed in the U. S. The methods of fastening the wood and metal parts together have been given special attention. 1600 w. Eng Rec—Dec. 10, 1910. No. 19278.

**Locks.**

See Concrete, under CONSTRUCTION.

**Marine Staging.**

A Locomotive Stage. Illustrates and describes the Piercy locomotive stage that walks to its work. 1800 w. Sci Am—Dec. 10, 1910. No. 19245.

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**Messina.**

Projects for the Rebuilding of the City and Harbor of Messina (Il Piano Regolatore della Citta e del Porto di Messina). A brief review of plans for repairing the damage done by the earthquake of 1908. Ills. 2800 w. Ann d Soc d Ing e d Arch Ital—Oct. 15, 1910. No. 19648 F.

**Mississippi River.**

The Deep Waterway from St. Louis to Cairo: A review of Seven Proposed Plans for Securing a Fourteen-Foot Waterway. J. W. Woermann. Map and description of the physical characteristics of this section of the Mississippi, with plans for the improvement. Ills. 6500 w. Jour Assn of Engng Socs. Nov., 1910. No. 19721 C.

**Panama Canal.**

The Panama Canal in 1910. Vaughan Cornish. Maps, plans and description of work on each of the three divisions, with general discussion. 10000 w. Jour Soc of Arts—Dec. 9, 1910. No. 19411 A.

Panama Canal in 1913. An interview with Mr. B. N. Baker, who considers that it will be possible to send a ship through the canal in 1913. 1200 w. Mfrs' Rec—Dec. 1, 1910. No. 19038.

**Piers.**

Reinforced-Concrete Piers at the U. S. Naval Station, Olongapo, Philippine Islands. C. A. Carlson. Illustrated detailed description of piers for berthing vessels of deep draft, having new features of interest. Construction is described. 4000 w. Eng News—Dec. 15, 1910. No. 19361.

**River Regulation.**

See Danube, under WATERWAYS AND HARBORS.

**Water Powers.**

Conservation of Water Powers of Canada. F. D. Monk. An address before the Caledonian Soc. on the work of the Conservation Commission. 3000 w. Can Elec News—Dec., 1910. No. 19120.

A Proposed Platform of Principles Governing State and Federal Control of Water Power Development. Gives a plan drafted by Philip P. Wells. 1200 w. Eng News—Dec. 15, 1910. No. 19358.

Water Power Regulation in Pennsylvania. Farley Gannett. An account of the methods of supervising and granting of water power franchises which have been in use for five years. 1800 w. Eng Rec—Dec. 3, 1910. No. 19081.

# ELECTRICAL ENGINEERING.

## COMMUNICATION.

**Fire Alarms.**

New York Fire Alarm System. Information concerning the reconstruction of the system. Ills. 1800 w. Munic Jour & Engr—Dec. 21, 1910. No. 19507.

A New Fire-Alarm System. Brief illustrated description of the Reichel system. 600 w. Elec Rev, Lond—Dec. 9, 1910. No. 19421 A.

**Radiotelegraphy.**

The Periodicities and Damping Coefficients of Coupled Oscillators. John S. Stone. Read before Soc. of Wireless Tel. Engrs. Deduces expressions for the damping coefficients and periodicities of two coupled oscillators which will yield correct results in all practical cases. 2000 w. Elec Rev & W Elect'n—Dec. 3, 1910. No. 19098.

**Submarine Cables.**

Submarine Cable-Laying and Repairing. Charles Bright. Abstract of two lectures to the Royal Naval War College. Describes the work, types of cable used, and related matters. 1800 w. Elect'n, Lond—Dec. 9, 1910. Serial. 1st part. No. 19428 A.

A Proposed Cable Receiver Employing the Principle of Light Interference. Albert C. Crehore and George O. Squier. Explains reasons for suggesting a new form of cable receiver and describes the interference method. 1500 w. Elect'n, Lond—Dec. 9, 1910. No. 19427 A.

Submarine Cables for Long-Distance Telephone Circuits. W. A. J. O'Meara. Abstract of a paper read before the Inst. of Elec. Engrs. Describes early telephone cables, discussing the three methods of increasing the range, and describing the new Anglo-French cable, its laying and testing. Ills. 3000 w. Elect'n, Lond—Dec. 16, 1910. Serial. 1st part. No. 19582 A.

**Telephone Cables.**

See Submarine Cables, under COMMUNICATION.

**Telephone Exchanges.**

The Value of a Party-Line Lock-Out System in Reducing Depreciation of Telephone Exchanges. W. J. Miskella. Explains the advantages of the party-line lock-out system. 2000 w. Elec Rev & W Elect'n—Dec. 10, 1910. No. 19269.

**Telephone Instruments.**

Composite Artillery Type Telephone. Describes a telephone designed to operate either from a 30-volt central storage battery, or from two dry cells in each telephone. Ills. 1200 w. Jour U S Art—Nov.-Dec., 1910. No. 19553 D.

**Telephone Rates.**

Is a Rational Basis Possible for Telephone Rates? Dugald C. Jackson. Extracts from a paper before the Nat. Munic. League. Discusses the factors which should determine the rates, and gives the writer's methods of solving the problem. 3000 w. Eng News—Dec. 15, 1910. No. 19357.

*We supply copies of these articles. See page 839.*

Boston's New Telephone Rates. Ames G. Patterson. Describes the basis on which the telephone service in Boston and suburbs was being given, outlines the new plan, and gives an account of the work required in making the change. Ills. 5800 w. Harvard Engng Jour—Nov., 1910. No. 19756 D.

**Telephony.**

Researches on the Transmitter and on Long-Distance Telephony. Béla Gáti. Abstract of a paper read at the Int. Con. of European Telephone & Telegraph Administrations, Paris. Ills. 3300 w. Elec Rev & W Elect'n—Dec. 24, 1910. No. 19537.

## DISTRIBUTION.

**Current Rectifiers.**

Mercury Arc Rectifiers. H. A. Cooch. Describes types and gives information concerning their efficiency. Ills. 2000 w. Ap Sci—Dec., 1910. No. 19725 C.

**Fuses.**

The Theory of Fuses (Zur Theorie der Schmelzsicherungen). E. Jasse. A detailed mathematical discussion. Ills. Serial. 1st part. 3300 w. Elektrotech u Maschinenbau—Nov. 20, 1910. No. 19829 D.

Tests of Diazed Fuses (Versuche mit elektrischen Schmelzsicherungen, bestehend aus Zweiteiligen Schraubstöpseln). Paul H. Perls. Gives results of official tests in Germany. Ills. 4000 w. Elek Kraft u Bahnen—Nov. 24, 1910. No. 19824 D.

## DYNAMOS AND MOTORS.

**A. C. Generators.**

The Parallel Operation of Compound-Wound Alternators. R. L. Mossman. Illustrated article showing how a compound winding was changed to simple winding to make the machines work easily in parallel. 700 w. Power—Dec. 13, 1910. No. 19291.

Low-Speed Vertical Alternators (Alternateurs à Arbre Vertical à Faible Vitesse de Rotation). L. Legros. Describes recent direct-connected units built by the Oerlikon Company. Ills. Serial. 1st part. 2500 w. Bul Tech d l Suisse Romande—Nov. 10, 1910. No. 19635 D.

Some Characteristics of the Commutator Generator (Ueber einige Eigenschaften der Kommutatorgeneratoren). R. Van Cauwenberghe. Records some experiments with a shunt-wound single-phase commutator motor run as a generator. Ills. 3600 w. Elektrotech u Maschinenbau—Nov. 6, 1910. No. 19825 D.

**A. C. Turbo-Generators.**

See Turbine Tests, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

**Heating.**

Check Calculation of the Heating in the Magnet Coils of Direct-Current Machines (Kontrollrechnung der Magnetspulen von Gleichstrommaschinen bezüglich Erwärmung). Thomas Rosskopf. Suggests a method differing from the usual practice. Ills. 2800 w. Elektrotech u Maschinenbau—Nov. 27, 1910. No. 19832 D.

**Induction Motors**

Recent Developments in Induction Motor Design. An illustrated review of improvements introduced, and arrangements adopted by different makers. 2000 w. Elec Rev, Lond—Dec. 16, 1910. No. 19578 A.

Care and Maintenance of Induction Motors. R. H. Fenkhausen. Illustrated suggestions for the care of this type of motor. 1500 w. Power—Dec. 6, 1910. Serial. 1st part. No. 19138.

## ELECTRO-CHEMISTRY.

**Corrosion.**

See Reinforced Concrete, under CIVIL ENGINEERING, MATERIALS OF CONSTRUCTION.

**Electric Furnaces.**

Temperature Drop, a True Measure of Thermal Resistance. Carl Hering. Aims to show that there exists an easily understood unit of thermal resistivity—a drop in temperature in degrees,—just as watts are a true measure of thermal conductivities. 2000 w. Met & Chem Engng—Dec., 1910. No. 19303 C.

Small Tubular Resistance Furnaces. Albert A. Somerville. Information concerning the construction and use of small furnaces of the electrical resistance type. Ills. 600 w. Elec Wld—Dec. 22, 1910. No. 19480.

The Electrometallurgy of Iron and Steel (Elektrische Eisen- und Stahlerzeugung). Dr. Juliusburger. Describes the new furnaces and installations of the Nathusius, Frick, Hiorth, and Ischewsky furnaces. 2000 w. Elek Kraft u Bahnen—Nov. 14, 1910. No. 19822 D.

**Electrochemistry.**

The Progress in Electrochemistry during 1906, 1907, and 1908 (Progrès de l'Electrochimie Technique pendant les Années 1906, 1907 et 1908). A detailed review of literature and patents covering the electrochemistry of metals. Ills. 7000 w. Rev d'Electrochimie—Oct., 1910. No. 19624 F.

**Electrolytic Cells.**

An Electrolytic Cell for Household Use. Charles F. Burgess. Illustrated description of a silver-cleaning apparatus, explaining its action. 1600 w. Wis Engr—Dec., 1910. No. 19518 C.

**Electroplating.**

Electro-Plating of Metals. Illustrates and describes methods of nickel-plating. 3000 w. Sci Am Sup—Dec. 24, 1910. No. 19492.

An Electrolytic Galvanizing Apparatus (Vorrichtung zum elektrolytischen Galvanisieren von Wassenartikeln). G. J.

*We supply copies of these articles. See page 839.*

Roman. Describes an apparatus for electroplating small articles. Ills. 1500 w. Galvan u Metal—Nov., 1910. No. 19663 D.

**Organic Substances.**

The Electrochemistry of Organic Substances from 1907 to 1910 (L'Electrochimie des Corps organiques, résumé de 1907 a 1910). A. Gerngross. A review of the literature of the subject. Serial. 1st part. 2000 w. Rev d'Electrochimie—Aug.-Sept., 1910. No. 19623 F.

## ELECTRO-PHYSICS.

**Alternating Currents.**

Generating Alternating Currents of Any Frequency. Dr. Alfred Gradenwitz. Explains a scheme for utilizing periodic fluctuations, generated by artificial means, for the generation of alternating currents. 1200 w. Elec Rev, Lond—Dec. 2, 1910. No. 19312 A.

Crest Factors and Form Factors of Symmetric Periodic Curves. W. C. Clinton. Gives general expressions of the crest factor and form factor of periodic functions in terms of the harmonics. 1000 w. Elect'n, Lond—Nov. 25, 1910. No. 19184 A.

**Eddy Currents.**

Eddy Currents in Massive Conductors in Slots (Wirbelstromverlauf in massiven, in Nuten eingebetteten Leitern). Herr Angermann. A mathematical investigation of a rectangular conductor completely filling a slot. Ills. 3200 w. Elektrotech u Maschinenbau—Nov. 13, 1910. No. 19826 D.

**Magnetism.**

Usual Statement of Laws of Magnetic Attraction May Mislead. Carl Hering. A critical discussion of the inverse square law of magnetic attraction. Also editorial note. 1600 w. Elec Rev. & W Elect'n—Dec. 10, 1910. No. 19267.

The Magnetic Properties of Iron and Its Alloys in Intense Fields. Sir Robert A. Hatfield, and Prof. B. Hopkinson. Gives a summary of results thus far obtained in an examination of a series of alloys, describing the apparatus. Ills. 12700 w. Inst of Elec Engrs—Dec., 1910. No. 19426 N.

**Magnets.**

See Alloys, under MECHANICAL ENGINEERING, MATERIALS OF CONSTRUCTION.

## GENERATING STATIONS.

**Accumulators.**

The 1910 Edison Storage Battery. Walter E. Holland. Abstract of a paper read before the Assn. of Edison Ill. Co.'s. Describes methods of testing and presents results of tests. 3500 w. Elec Rev & W Elect'n—Dec. 3, 1910. No. 19097.

See also Electric, under MECHANICAL ENGINEERING, AUTOMOBILES; Wind Power, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

**Central Stations.**

Station of the Empire District Electric Company. M. R. Bump. Illustrated description of a steam turbine plant equipped for storing coal under water and operating in parallel with hydroelectric and gas-engine stations, to supply electrical energy to the lead and zinc mines of the Joplin district of Missouri, Kansas and Oklahoma. 1500 w. Elec Wld—Dec. 1, 1910. No. 19047.

The Randfontein Gold-Mines Power-Station. Illustrated description of a central station in the Transvaal to furnish power for a group of mines. 1500 w. Engng—Nov. 25, 1910. No. 19193 A.

Swedish Generating Station. E. Andreason. Illustrated description of the extension of the municipal steam electric power station of Stockholm. 2500 w. Elec Wld—Dec. 8, 1910. No. 19226.

The Electric Installations of the Metropolitan of Paris (Les Installations électriques du Chemin de Fer Métropolitain de Paris). J. Quinat. A detailed description of the generating and transmitting equipment. Ills. Serial. 1st part. 6300 w. Génie Civil—Nov. 5, 1910. No. 19638 D.

See also Refuse Destructors, under CIVIL ENGINEERING, MUNICIPAL.

**Economics.**

Central-Station Heating to Conserve the Natural Resources. F. H. Stevens. Explains the advantages and economy of central-station heating. 1500 w. Elec Wld—Dec. 8, 1910. No. 19229.

**Hydro-Electric.**

The Water-Power Industry of Sweden (Die Wasserkraftindustrie Schwedens). Sven Lübeck. A brief review of its development and present status. 5000 w. Die Turbine—Nov. 5, 1910. No. 19696 D.

Hydro-Electric Practice. H. A. von Schon. The importance of accurate determination of the precipitation and run-off in determining the commercial value of an undertaking. 2200 w. Munic Engng—Dec., 1910. No. 19730 C.

The Design of Water-Power Plants (Zur Behandlung der Bauformen Kleinerer Wasserkraftanlagen). C. Reindl. Discusses the aesthetic side of the design of buildings to house hydro-electric machinery. Ills. 2000 w. Zeitschr f d Gesamte Turbinenwesen—Nov. 10, 1910. No. 19800 D.

Low-Head Hydroelectric Development. Brief illustrated description of the new 10,000-kw. power station of Chippewa Railway, Light, & Power Co. at Cedar Falls, Wis. 2000 w. Elec Wld—Dec. 22, 1910. No. 19478.

Interconnected Electrical Transmission System. Illustrated description of the hydraulic installation of the Central Maine Power Company, utilizing the Kennebec River. 2000 w. Elec Wld—Dec. 15, 1910. No. 19350.

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Hydroelectric Development at San Juancito, Honduras. Gives general arrangement of machines, and turbine details in the station, describing a development to supply power for mining. 1200 w. Eng Rec—Dec. 17, 1910. No. 19391.

The Hydro-Electric Power Plant on the Jhelum River in Kashmir, India. Heinrich Homberger. Gives the history of the project and illustrated description of the development. 5000 w. Jour Assn of Engng Socs—Nov., 1910. No. 19722 C.

The Ventavon Hydroelectric Plant. C. L. Durand. Illustrated description of a modern 30000 h.p. plant in France. 2500 w. Elec Rev & W Elect'n—Dec. 10, 1910. No. 19266.

The Beswitz Hydro-Electric Plant (Usine hydraulico-electrique de Beswitz, Allemagne). H. Marchand. Describes a plant in Germany intended to supply energy for agricultural purposes. 2000 w. L'Elecn—Nov. 26, 1910. No. 19634 D.

**Isolated Plants.**

Western Union Plant in Chicago. Osborn Monnett. Illustrates and describes the mechanical equipment furnishing power for a system of independent electric drives in connection with all the machines of a large printing establishment. 1200 w. Power—Dec. 20, 1910. No. 19457.

Power-Requirement Determination in the Design of a Railway-Shop Power Plant (Zur Berechnung des Kraftwerkes für eine Eisenbahnhauptwerkstatt: Versuche über Grösse und Wechsel des Kraftbedarfes). Bruno Schwarze. Detailed explanation of methods of determining the maximum power demand and the probable variations in demand. Ills. 3800 w. Elek Kraft u Bahnen—Nov. 24, 1910. No. 19823 D.

See also Turbine Plants, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

**Italy.**

The Principal Generating Stations in Italy (I Principali Impianti Electrici d'Italia). A review of the recent vast development of the electricity supply industry. 4600 w. Monit Tech—Nov. 10, 1910. No. 19653 D.

**Power Factor.**

The Power Factor of a Three-Phase System (Der Leistungsfaktor eines Drehstromsystems). F. Niethammer. Mathematical discussion of the proper definition of the power factor of a system with unequally loaded phases. Ills. 1800 w. Elektrotech u Maschinenbau—Nov. 27, 1910. No. 19833 D.

**Rates.**

How Hydroelectric Energy Displaces Coal. Alton D. Adams. Discusses the amount and price of sales of energy made by various hydroelectric systems to consumers. Editorial note. 3000 w. Elec Wld—Dec. 1, 1910. No. 19048.

The Rate Question. H. C. Abell. Comments on recently published articles discussing rates, giving the author's opinions. 1000 w. Elec Wld—Dec. 22, 1910. No. 19481.

The History and Economics of Central Station Rate Making. M. D. Cooper. Brief review of the history of rate making. 3500 w. Wis Engr—Dec., 1910. No. 19517 C.

Central-Station Rates (Zur Tariffrage). Kasimir Gajczak. Discusses certain features of the rate-making problem. Ills. 2000 w. Elektrotech u Maschinenbau—Nov. 20, 1910. No. 19830 D.

**Switchgear.**

See Electric Power, under MINING AND METALLURGY, COAL AND COKE.

## LIGHTING.

**Arc Lamps.**

Three-Phase Arcs with Four Carbons. L. Crouch. Explains the good results recently obtained by Righi by the use of four carbons. Ills. 800 w. Elec Rev, Lond—Dec. 9, 1910. No. 19420 A.

**Illumination.**

The New Era in Electrical Illumination. Rollin W. Hutchinson, Jr. This second article of a series deals with flaming, luminous-arc and vapor lamps. Ills. 3500 w. Engineering Magazine—Jan., 1911. No. 19741 B.

Some Practical Observations on Illumination. A. G. Rakestraw. Deals with different kinds of illuminants, and their application. 2500 w. Sib Jour of Engng—Nov., 1910. Serial. 1st part. No. 19020 C.

Graphical Solution of Problems Involving Plane-Surface Lighting Sources. A. S. McAllister. Explains the graphical solution and outlines the proof of its accuracy. Also editorial note. 3300 w. Elec Wld—Dec. 8, 1910. No. 19227.

Indirect Lighting of Churches. Brief illustrated description of a model installation at Rome, N. Y. 600 w. Elec Rev & W Elect'n—Dec. 24, 1910. No. 19536.

Notes on Drafting Room Lighting. C. E. Clewell. Includes experiments for determining intensity and the arrangement and number of lamps required. Ills. 2000 w. Elec Jour—Dec., 1910. No. 19514.

The Mazda Lamp with a Few Common Types of Reflectors. R. Horatio Wright. Illustrated article showing the effect of light distribution by the use of different reflectors. 1500 w. Sib Jour of Engng—Nov., 1910. No. 19021 C.

The Lighting of the Allegheny County Soldiers' Memorial. Bassett Jones, Jr. Abstract of a paper before the N. Y. Sec. of the Ill. Engng. Soc. Illustrates and describes the architectural features and illuminating equipment of a beautiful building in Pittsburgh. Colored screens and colored illuminants are used. Also editorial. 3000 w. Elec Wld—Dec. 15, 1910. No. 19353.

*We supply copies of these articles. See page 839.*

Electrical Equipment of the Landau Municipal Auditorium (Die technischen Einrichtungen der städtischen Festhalle in Landau). Julius Weil. The first part describes the illumination of the great hall. Ills. Serial. 1st part. 2000 w. Elektrotech Rundschau—Nov. 10, 1910. No. 19818 D.

**Incandescent Lamps.**

The Metal Lamp Filament. Dr. H. F. Baumhauer. Trans. from *Zeit. fuer Angewandte Chemie*. Describes their manufacture. 2500 w. Sci Am Sup—Dec. 24, 1910. No. 19491.

**Mercury-Vapor Lamps.**

See Vacuum Tubes, under LIGHTING.

**Military Signals.**

An Improved Ardois. Paul D. Bunker. Describes a system for quick and efficient night signaling. Ills. 1500 w. Jour U S Art—Nov.-Dec., 1910. No. 19552 D.

**Reflectors.**

The Cooper Hewitt Light-Transforming Reflector. Joseph B. Baker. Explains the application of this reflector to vacuum tubes and to incandescent lamps, describing results. 1500 w. Sci Am—Dec. 24, 1910. No. 19490.

**Street.**

Street Lighting by Modern Electric Lamps. Haydn T. Harrison. Gives details of street lighting of St. Marylebone, where incandescent gas lamps have been replaced with metal filament lamps, discussing efficiency, equitable charge, etc. 8500 w. Inst of Elec Engrs—Nov. 24, 1910. No. 19181 N.

Public Lighting in the City of London. Reviews the history of electric lighting in London and describes the schemes recently put in operation. Ills. 4000 w. Elect'n, Lond—Dec. 16. 1910. Serial. 1st part. No. 19581 A.

Street-Lighting Costs. C. Toone. On the costs of running and upkeep of various electric street lamps. 1200 w. Elec Rev, Lond—Nov. 25, 1910. Serial. 1st part. No. 19179 A.

Arc Lamp-Posts of New York. Illustrates and describes details of the ornamental standards used. 2500 w. Elec Wld—Dec. 8, 1910. No. 19230.

Mercury-Vapor Quartz Lamps. Maurice Leblanc, Jr. Abstract trans. from *La Lumière Elec.* Describes these lamps and their high efficiency, and gives information relating to them. 2000 w. Elec Rev & W Elect'n—Dec. 17, 1910. No. 19404.

## MEASUREMENT.

**Cable Testing.**

Tests of an Underground Transmission System after Installation (Essais des Canalisations Souterraines après Pose). M. Armagnat. Describes methods and apparatus used. Ills. 5400 w. Bul Soc Int d Elecns—Nov., 1910. No. 19608 F.

See also Cables, under TRANSMISSION.

**Capacity.**

See Insulation Testing, under MEASUREMENT.

**Dynamo Testing.**

A Comparison of Three Methods of Measuring the Efficiency of Direct-Current Machines (Comparaison de Trois Méthodes de Mesure du Rendement des Machines à Courant Continu). A report of comparative results of the Swinburne, Kapp, and Fontaine and Cardew methods. Ills. 2000 w. Soc Belge d'Elecns—Oct., 1910. No. 19605 E.

**Frequency.**

Frequency Meters. Dr. O. Martienssen. Abstract of an article in *Elek. Kraftbetriebe und Bahnen*. Describes some well-known types severally depending on totally distinct principles. 1000 w. Elect'n, Lond—Nov. 25, 1910. No. 19183 A.

**Insulation Testing.**

The Theory of Insulation Testing and Capacity Measurement in Plants under Operation (Die Theorie der Isolations- und Kapazitätsmessungen an Anlagen im Betrieb). H. Hausrath. A detailed theoretical description of methods. Ills. Serial. 1st part. 4000 w. Elektrotech u Maschinenbau—Nov. 13, 1910. No. 19828 D.

**Laboratories.**

The High-Tension Laboratory at the Danzig Technical High School (Das Hochspannungslaboratorium des Elektrotechnischen Instituts der Technischen Hochschule in Danzig). G. Roessler. Illustrated description of the equipment. 5600 w. Zeitschr d Ver Deutscher Ing—Nov. 12, 1910. No. 19839 D.

**Magnetic Flux.**

A New Method of Measuring the Strength of Magnetic Fields. Prof. W. Bukert. Abstract of an article in the *Elektrotechnische Zeit.* Describes a method depending on the Hall effect, which is especially noticeable in bismuth, which is used. 400 w. Elect'n, Lond—Nov. 25, 1910. No. 19182 A.

**Resistance.**

The Direct Measurement of High Resistance by a Megger. Arthur J. Rowland. Illustrated description of an instrument of the permanent-magnet-moving-coil type, and its use. 1500 w. Cent Sta—Dec., 1910. No. 19280.

Measurement of Self-Inductance and Effective Resistance at High Frequencies. Charles E. Hay. Describes a method devised and used by the writer. 500 w. Elec Rev, Lond—Dec. 9, 1910. No. 19425 A.

**Resistance Standards.**

A New Form of Non-Inductive Low-Resistance Standard, or Shunt. Dr. C. V. Drysdale. The resistance described is made by cutting the electrodes into a number of thin strips which intercalate with one another, reducing the inductance to a very small figure. Ills. 1000 w. Elect'n, Lond—Dec. 9, 1910. No. 19429 A.

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## POWER APPLICATIONS.

**Heating.**

The Present Position of Electric Heating and Cooking. Gives a summary of replies to questions sent to station engineers. Also editorial. 8500 w. Elect'n, Lond—Dec. 2, 1910. No. 19313 A.

Electric Hot-Water Supply System. Joseph B. Baker. Illustrated description of an electric heat storage system for supplying electrically heated water in considerable quantities. 1000 w. Sci Am—Dec. 3, 1910. No. 19100.

**Pumping.**

See Pumping Plants, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

**Tanning.**

Electricity in the Tanning Industry. Illustrated description of an installation of more than usual interest in a tannery at Kenosha, Wis. 2000 w. Elec Rev & W Elect'n—Dec. 3, 1910. No. 19096.

**Turn Tables.**

See same title, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

## TRANSMISSION.

**Alternating Currents.**

Currents in Delta-Connected Circuits. B. F. Jacobsen. Investigates the relation which exists between line currents as measured by the switchboard instruments and the currents in each phase of the delta-connected generator. 1000 w. Elec Wld—Dec. 15, 1910. No. 19351.

Solution of Problems in Star-Connected Unbalanced Three-Phase Circuits. Chesley H. Johnson. Treats of the vector diagrams of unbalanced star loads of known impedance connected to a given delta triangle of three-phase line voltages. 1500 w. Elec Wld—Dec. 15, 1910. No. 19352.

**Cables.**

Discussion on "Potential Stresses in Dielectrics." New York, October 17, 1910. Discussion on paper by Harold S. Osborne and Harold Pender. 13500 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19712 F.

Cable Tests at the Central Electrical Laboratory, Paris (Essais de Cables pour Canalisations électriques effectués au Laboratoire central d'Electricité). Ch. David. Reports an investigation of electric cables for use in the French Navy, covering the effects of bending, the effects of heat on the insulation, and the heating of cables by the current. Ills. 18000 w. Bul Soc Int d Elecns—Oct., 1910. No. 19607 F.

The Specifications of the Union des Syndicats for Lead-Covered Cables for Tensions above 2,000 Volts (Observations sur le Cahier des Charges de l'Union des Syndicats, relatif aux Cables sous Plomb armés, pour Tensions supérieures à 2,000 Volts). M. Grosselin. Gives the text of the specifications and a discussion of the terms. Ills. 5000 w. Bull Soc Int d Elecns—Nov., 1910. No. 19609 F.

See also Cable Testing, under MEASUREMENT; and Electric Power, under MINING AND METALLURGY, COAL AND COKE.

**Economics.**

The Calculation of the Maximum Economy of an Electrical Transmission System (La Calcolazione di Massimo Tornaconto delle Linee per Trasmissione Elettrica di Energia). Giacinto Motta. A mathematical discussion of transmission-line repairs, depreciation, amortization, energy losses, etc. Ills. Serial. 1st part. 3000 w. Monit Tech—Nov. 10, 1910. No. 19651 D.

**Grounding.**

Some Notes on Ground Connections. Edgar H. Holmes. Describes some methods of making ground connections and gives some performance data. Ills. 1500 w. Elec Wld—Dec. 1, 1910. No. 19049.

**Lines.**

See Central Stations, under GENERATING STATIONS.

**Line Terminals.**

Brick Tower Terminals for Overhead Lines. Drawings and description, explaining advantages. 1200 w. Elec Engr, Lond—Nov. 25, 1910. No. 19176 A.

**Regulations.**

The French Law of March 21, 1910, and the Regulations of the Union des Syndicats (Quelques Remarques à Propos de l'Arrêté du 21 Mars 1910 et des Instructions de l'Union des Syndicats). M. Boucherot. Discusses the new French regulations relative to safety devices on transmission lines, and the specifications of the Union des Syndicats relative to the acceptance and installation of transformers. Ills. 5200 w. Bul Soc Int d Elecns—Nov., 1910. No. 19610 F.

Some Points in Connection with Transformers. Considers the transformer from the viewpoint of the operating engineer. 2200 w. Elec Rev, Lond—Dec. 9, 1910. No. 19422 A.

Single Phase Transformer Connections. Norman G. Meade. Diagrams and explanations. 1000 w. Power—Dec. 27, 1910. No. 19575.

Problems in the Operation of Transformers. F. C. Green. Considers the selecting of transformers designed to meet the service requirements, the installing, causes of failures, care in operating, connections, etc. 4000 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19711 F.

See also Regulations, under TRANSMISSION.

**Voltage Regulation.**

Modern Induction Regulators, Their Usages and Results. F. W. Shackelford.

Illustrates and describes apparatus made by the General Electric Company. 1800 w. Elec Rev & W Elect'n—Dec. 24, 1910. No. 19535.

**Wires.**

Electrical Properties of Compound Wires. Frank F. Fowle. Information concerning recent improvements in their construction, and the usefulness of copper-clad steel wires, and gives results of a study of their electrical properties. 2500 w. Elec Wld—Dec. 22, 1910. No. 19479.

## MISCELLANY.

**Canada.**

Openings for Electrical Enterprises in the Canadian Northwest. Explains the important part electricity will assume in the development of the country, suggesting places where its development is of immediate importance. 2500 w. Elec Rev, Lond—Nov. 25, 1910. No. 19180 A.

**Copper.**

The Electrical Conductivity of Commercial Copper. F. A. Wolff and J. H. Dellinger. Abstract of a paper to appear in Bul. of Bureau of Standards. Experimental investigation and results of tests made to furnish data to be used in establishing more reliable standard values. 4000 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19713 F.

The Temperature Coefficient of Resistance of Copper. J. H. Dellinger. Abstract of a paper to appear in Bul. of Bureau of Standards. A report of investigations. 4000 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19714 F.

**Exhibitions.**

Electricity at the Brussels Exposition (Die Elektrotechnik auf der Weltausstellung in Brüssel 1910). Herr Hentschel. A review of the electrical exhibits. Ills. Serial. 1st part. 3200 w. Glasers Ann—Nov. 15, 1910. No. 19808 D.

**Industry.**

What's Wrong with the Electrical Industry? H. A. Carney. Read before the Manchester Students' Section of I. E. E. Discusses some of the causes given to explain the unsatisfactory condition of the industry in England, and how to put it right. 5000 w. Elec Engr, Lond—Dec. 9, 1910. No. 19418 A.

# INDUSTRIAL ECONOMY.

**Accounting.**

The Balance Sheet (Le Bilan dans l'Industrie). Maurice Bellom. Discusses the desiderata in a balance sheet in industrial accounting and the means of attainment. 2800 w. Génie Civil—Nov. 26, 1910. No. 19645 D.

**Apprenticeship.**

The Revival of Apprenticeship. G. Basil Barham. Discusses the question in its relation to the electrical industry. 2000 w. Elec Rev, Lond—Dec. 9, 1910. No. 19423 A.

Apprenticeship System of the Lehigh Valley at the Sayre Shops. R. A. Hunt. Brief description. 800 w. Ry Age Gaz—Dec. 2, 1910. No. 19117.

The Crisis of Apprenticeship (La Crise de l'Apprentissage). E. Bertin. A study of present conditions in France, with suggestions for remedies. 4000 w. Tech Mod—Nov., 1910. No. 19621 D.

Technical Apprentice Courses and Preapprenticeship Courses (Cours Techniques d'Apprentis et Cours de Préapprentissage). A. Jully. Discusses conditions in engineering and industrial education in France and offers suggestions for their improvement. 6500 w. Bul Soc d'Encour—Nov., 1910. No. 19629 G.

**Argentina.**

Argentina from a British Point of View. Campbell P. Ogilvie. Information concerning the country, its industries trade, etc. 7500 w. Jour Soc of Arts—Dec. 2, 1910. No. 19307 A.

**Cost Systems.**

The Various Elements of Cost. Holden A. Evans. Considers the importance of accuracy in obtaining direct labor charges, material charges, indirect cost, depreciation, etc. 5500 w. Am Mach—Vol. 33. No. 49. No. 19211.

**Depreciation.**

Determining Amortization in Industrial Plants (De l'Allure de l'Amortissement industriel). Maurice Bellom. A mathematical study of the method of calculating the annual amortization. Ills. 4500 w. Tech Mod—Nov., 1910. No. 19622 D.

See also Public Utilities, under INDUSTRIAL ECONOMY.

**Education.**

Legislation Upon Industrial Education in the United States. Prepared by Edward C. Elliott and C. A. Prosser. 18000 w. Nat Soc for Pro of Ind Ed—Bul. No. 12. No. 19494 N.

Limitations of Efficiency in Engineering Education. George Fillmore Swain. Extracts from an address at Union College, Schenectady. Considers what an engineering graduate should be, some of the difficulties met, and suggests remedies. 6500 w. Eng Rec—Dec. 17, 1910. No. 19390.

Commercial Training of the Engineer. E. Kilburn Scott. Gives the main heads of a syllabus drawn up by the author for a course on Quantities and Estimates, explaining methods. 2000 w. Elec Engr, Lond—Dec. 9, 1910. No. 19417 A.

*We supply copies of these articles. See page 839.*

The Production of Foundrymen. John Jermain Porter. Explains the methods of foundry instruction in the co-operative engineering course of the University of Cincinnati. 1500 w. Am Brass Found Assn—1910. No. 19014 N.

The Educational Bureau of the Union Pacific Railroad. Dexter C. Buell. An account of the work undertaken to increase the efficiency of railway officials and employees. Also discussion. 12800 w. Pro Cent Ry Club—Nov. 11, 1910. No. 19752 C.

The Mechanical Specialist, Coast Artillery Corps. Offnere Hope. Explains the aim and scope of the education given to engineers and firemen. Ills. 3500 w. Jour U S Art—Nov.-Dec., 1910. No. 19550 D.

The Industrial Training of Boys. J. J. Flather. Read before the Nat. Founders' Assn. Discusses the education and the development of the apprentice. 3500 w. Ir Age—Dec. 8, 1910. Serial. 1st part. No. 19224.

German and American Trade Schools. Paul Kreuzpointner. Considers the German system and the reasons for its success. 2500 w. Am Mach—Vol. 33. No. 50. No. 19349.

The Organization of Technical High Schools (Zur Organisation der Technischen Hochschulen). Cornelius Gurlitt. A discussion of conditions in engineering education in Germany. Serial. 1st part. 3300 w. Deutsche Bau—Nov. 23, 1910. No. 19691 B.

The Opening of the Breslau Technical High School (Zur Eröffnung der Technischen Hochschule in Breslau). Describes the laboratory equipment. Ills. 2000 w. Stahl u Eisen—Nov. 30, 1910. No. 19675 D.

See also Laboratories, under MECHANICAL ENGINEERING, HYDRAULIC MACHINERY.

**Engineering.**

Influence of Pure Science in Engineering. Sir J. J. Thomson. Pres. address before the Jun. Inst. of Engrs. 4000 w. Elec Engr, Lond—Nov. 25 1910. No. 19178 A.

Some Mistakes of an Unsuccessful Engineer. A report of mistakes in dealing with men which will be of interest to young engineers. 6000 w. Eng News—Dec. 22 1910. No. 19483.

**Exhibitions.**

The Turin Exhibition. Illustrations and information in regard to the international exhibition to be opened in April to commemorate the fiftieth anniversary of the foundation of the Kingdom of Italy. 2000 w. Engr, Lond—Dec. 16, 1910. No. 19701 A.

**Industrial Accidents.**

See Accidents, under MINING AND METALLURGY, MINING.

**Labor Agreements.**

The Shipbuilding Workers' Agreement. Editorial discussion. 3000 w. Engng—Dec. 16, 1910. No. 19597 A.

**Labor Legislation.**

Significance of Legislative Records. Marshall Cushing. Read before the Nat. Found. Assn. Discusses Congressional action on labor questions and the bearing of recent election results on possible labor laws. 4500 w. Ir Trd Rev—Dec. 1, 1910. No. 19059.

**Management.**

The Twelve Principles of Efficiency. Harrington T. Emerson. This eighth article of a series discusses the sixth principle: reliable, immediate and adequate records. 3500 w. Engineering Magazine—Jan., 1911. No. 19740 B.

Systematic Foundry Operation and Foundry Costs. C. E. Knoeppel. This fourth article of a series discusses production and the control of productive operations. 3500 w. Engineering Magazine—Jan., 1911. No. 19744 B.

Foundry and Machine Shop Agreement. Walter J. May. Suggestions for securing economy in the total cost of any article. 1000 w. Prac Engr—Dec. 16, 1910. No. 19584 A.

Graphical Charts in Factory Management (Graphische Statistik im Dienste der Fabrikorganisation). C. M. Lewin. Shows the value and methods of graphical representation of industrial statistics. Ills. 4000 w. Zeitschr f Werkzeug—Nov. 15, 1910. No. 19816 D.

**Monopoly.**

Monopoly and Progress. Dr. Franz Erich Junge-Hermsdorf. A brief résumé of the history of public lands and resources in the United States as the foundation of private monopoly power. First of three articles. 3000 w. Engineering Magazine—Jan., 1911. No. 19739 B.

**Public Utilities.**

Valuation of Public Utilities. Clinton S. Burns. Discusses depreciation and present value, deducing formulae, and explaining a new method of appraisement. 3000 w. Munic Jour & Engr—Nov. 30, 1910. No. 19061.

The Valuation of Public Service Corporation Property. Henry Earle Riggs. Considers the reasons for requiring such valuations, and discusses the methods which should be used in arriving at a correct cost of reproduction and depreciation. 60000 w. Pro Am Soc of Civ Engrs—Nov., 1910. No. 19035 F.

**Wage Systems.**

An Innovation in Wage Scales. Albert Halstead. Brief account of a new rate of wages soon to become operative in England under which workers will be graded according to their qualifications and capacity. 1200 w. Am Mach—Vol. 33. No. 50. No. 19346.

# MARINE AND NAVAL ENGINEERING.

**Ammunition.**

The Stability of Smokeless Powder. J. Strauss. A study of the duration of powder in a safe condition and its testing. Also general discussion. 10000 w. Pro U S Nav Inst—Dec., 1910. No. 19548 E.

**Battleships.**

Dreadnoughts—What Are They? Sidney Graves Koon. Illustrated discussion of these vessels as the most advanced battleship types. 5000 w. Engineering Magazine—Jan., 1911. No. 19742 B.

Notes on the Armaments of Battleships. Sir William H. White. A summary of the principles which shall regulate the armaments of modern battleships, with a review of present practice and tendencies. 8000 w. Soc of Nav Archts & Marine Engrs, No. 1—Nov. 17, 1910. No. 19460 N.

The Armament of Battleships. Editorial review of Sir William White's paper on this subject, read before the Soc. of Nav. Archts. & Marine Engrs. in New York. 2500 w. Engr, Lond—Dec. 2, 1910. No. 19333 A.

Four Recent Types of Dreadnoughts. Digest of a paper by Luigi Barberis, translated from *Rivista Marittima*. The four ships are the Russian "Sebastopol" class of four ships; the American "Wyoming" and "Arkansas;" the Argentine "Rivadavia" and "Moreno;" and the French "Jean Bart" and "Courbet." Ills. 1500 w. Sci Am—Dec. 24, 1910. No. 19487.

An Analysis of Tests of Water-Tight Bulkheads with Practical Rules and Tables for Their Construction. William Havgaard. A continuation of a paper read one year ago. Further develops the theory advanced and gives an analysis of tests, with practical rules and tables. Ills. 7000 w. Soc of Nav Archts & Marine Engrs, No. 7—Nov. 17, 1910. No. 19466 N.

**Colliers.**

Coaling Warships—Notes of Progress. Spencer Miller. An illustrated paper describing the colliers and the coal-discharging gear. 5000 w. Soc of Nav Archts & Marine Engrs, No. 4—Nov. 17, 1910. No. 19463 N.

**Cruisers.**

The Cruiser Dixie; Tender to the Atlantic Torpedo Fleet. Paul Foley. Illustrated description of a repair and supply vessel to accompany a battleship fleet. 3000 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19031 H.

**Destroyers.**

Comparative Performance Data of Recent Destroyers. David F. Boyd. A report of recent trials and results, with matters related. 4000 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19024 H.

Description and Trials of Torpedo-Boat Destroyers Paulding and Drayton. H. C. Dinger. Illustrated description with report of trials. 10000 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19030 H.

**Electric Power.**

See Cables, under ELECTRICAL ENGINEERING, TRANSMISSION.

**Evaporators.**

Test of an Evaporator. S. M. Robinson. An account of tests made to determine the cost of evaporation and the advantages of operating under different conditions. Ills. 1200 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19027 H.

**Fire Prevention.**

Some Suggestions for Reducing the Loss by Fire on Vessels. Samuel D. McComb. Suggestions applying to wooden as well as steel vessels, and to small as well as large ones. 7000 w. Soc of Nav Archts & Marine Engrs, No. 11—Nov. 17, 1910. No. 19469 N.

**Gas Engines.**

Two Marine Installations of Producer Gas. Charles B. Page. Describes the installations on the "Mary A. Sharp," and on the "Superior," commercial vessels powered with producer gas. Ills. 2000 w. Soc of Nav Archts & Marine Engrs, No. 12—Nov. 17, 1910. No. 19470 N.

**Gyroscope.**

The Gyroscope for Marine Purposes. Elmer A. Sperry. Discusses the principal uses of the gyroscope at sea. Ills. 5000 w. Soc of Nav Archts & Marine Engrs, No. 9—Nov. 17, 1910. No. 19468 N.

**Naval Engieering.**

Naval Engineering Progress. H. I Cone. A lecture before the U. S. Naval War College. Reviews developments of the past year in naval engineering, particularly those affecting strategy and tactics. 7000 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19023 H.

**Propellers.**

Evolution of Screw Propulsion in the United States. Charles H. Cramp. The second part of a review of screw propulsion, covering the time from 1849. Ills. 2500 w. Soc of Nav Archts & Marine Engrs, No. 2—Nov. 17, 1910. No. 19461 N.

**Revolution Indicator.**

The McNab Marine Revolution Indicator. Illustrated description of an instrument which enables the revolutions of the main engines of a steamship to be indicated on the bridge or in the chart-house. 1000 w. Engng—Dec. 9, 1910. No. 19442 A.

*We supply copies of these articles. See page 839.*

**Salving.**

Army Plan for Uncovering the "Maine." Illustrated, with brief description. 900 w. Sci Am—Dec. 24, 1910. No. 19488.

**Scows.**

A 3000-Yard Steel Dump Scow. Interesting features in the design and methods of construction are described. 2000 w. Eng Rec—Dec. 17, 1910. No. 19386.

**Ship Design.**

The Block Coefficient. P. A. Hillhouse. Gives definitions and use of the block coefficient, methods of calculating, and formulae. 2000 w. Inst of Engrs & Shipbldrs in Scotland—Oct. 25, 1910. No. 19771 N.

The Isherwood System of Ship Construction (Das Isherwoodsystem). G. Buchsbaum. Describes and discusses a number of vessels built on this system. Ills. Serial. 1st part. 2200 w. Schiffbau—Nov. 9, 1910. No. 19685 D.

**Ship's Rolling.**

Tanks for Preventing the Rolling of Ships. Editorial discussion of Mr. Frahm's researches. 1600 w. Engng—Dec. 16, 1910. No. 19598 A.

**Steamboats.**

The Paddle Steamer Weeroona. Illustrates and describes this high-speed passenger vessel, recently completed, for tourist day-traffic on Port Philip Bay, Australia. 1500 w. Engr, Lond—Dec. 9, 1910. No. 19448 A.

**Steam Boilers.**

Report of Test of a Babcock & Wilcox Boiler for U. S. Battleships Wyoming and Arkansas. With notes by H. C. Dinger. Gives data from the report of the Board of Naval Officers. 3300 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19029 H.

**Steam Engines.**

The Practical Operation of Steam Turbines and Reciprocating Engines. Francis J. S. Nolan. Describes in detail the work necessary to overhaul reciprocating engines, comparing with turbines. 2500 w. Int Marine Engng—Dec., 1910. No. 19206 C.

The Economical Working of Reciprocating Marine Engines and Their Auxiliaries. D. B. Morison. Read before the N.-E. Coast Inst of Engrs. & Shipbldrs. Reviews the system on which main engines and their auxiliaries are worked with the aim of determining the best methods for commercial results. 5000 w. Engng—Dec. 2, 1910. Serial. 1st part. No. 19329 A.

Comparative Results in Steam and Coal Consumption with Turbines, Reciprocating Engines and a Combination of the Two on the Steam Yacht Vanadis. Clinton H. Crane. Describes tests and results. 2500 w. Soc of Nav Archts & Marine Engrs, No. 8—Nov. 17, 1910. No. 19467 N.

The German Naval Architects. Reports the meeting at Charlottenburg of the Schiffbautechnische Gesellschaft. The present number gives Prof. Stumpf's paper on "The Further Development of the Uni-flow Steam Engine," with discussion. 3500 w. Engr, Lond—Nov. 25, 1910. Serial. 1st part. No. 19196 A.

See also Air Pumps, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

**Steamships.**

The Evolution of Ocean Steamers. M. B. Cea. Brief description of the new Hamburg-American liner Europa. 1000 w. Cassier's Mag—Dec., 1910. No. 19544 B.

The Largest Ship: the "Europa." Illustrations and brief description of the new vessel of the Hamburg-American Line, a 50,000-ton passenger ship. 800 w. Sci Am—Dec. 17, 1910. No. 19366.

Notes on the Trials and Performances of the S. S. Otaki, Fitted with a Combination of Reciprocating and Turbine Machinery. W. McK. Wisnom. Read before the N.-E. Coast Inst. of Engrs. & Shipbldrs. Supplementing an earlier paper by C. A. Parsons. Gives particulars of the trials, and results. General discussion. 12500 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19028 H.

The French Liner France. Illustrated description of the largest and speediest boat of the French merchant marine. 1200 w. Int Marine Engng—Dec., 1910. No. 19207 C.

New Southern Pacific Freight Steamships. Illustrated description of single-screw steel vessels of the ocean-going, hurricane deck type. 2000 w. Int Marine Engng—Dec., 1910. No. 19205 C.

Random Notes on a Lake Freighter. Caspar F. Goodrich. Illustrations and notes on this type of vessel, the appliances for handling the immense cargoes, and matters related. 4800 w. Pro U S Nav Inst—Dec., 1910. No. 19549 E.

**Steam Turbines.**

See Steam Engines, under MARINE AND NAVAL ENGINEERING.

**Steering Gear.**

Electric Steering Gear for Ships. K. Trowbridge. Diagrams and brief explanations of various systems. 1000 w. Elec Rev, Lond—Dec. 16, 1910. No. 19579 A.

**Submarines.**

The Cruise of the Submarine Torpedo Boat Salmon from Quincy, Mass., to Hamilton, Bermuda, and Return, July 5, 17, 1910. D. A. Weaver. A detailed account of an extended deep-sea cruise made under the boat's own power. 2500 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19026 H.

**Tugs.**

A Single Screw Tug. Illustrated description of the tug George V, recently

built. 400 w. Engr, Lond—Dec. 16, 1910. No. 19703.

Shallow-Draught Tug for the River Lena. Illustrations and description of a paddle-boat drawing no more than 16 in., and capable of a speed of over 14 knots. 400 w. Engng—Nov. 15, 1910. No. 19192 A.

**U. S. Merchant Marine.**

Our Constitutional Shipping Policy and the Compact for Its Establishment. William W. Bates. Reviews the early history of the United States in relation to commerce and navigation and criticizes the legislation that has prevented the subsidizing of vessels. 3500 w. Soc of Nav Archts & Marine Engrs, No. 6—Nov. 17, 1910. No. 19465 N.

**Water Consumption.**

Some Tests on Board Ship to Ascertain the Water Consumption of Engine Room and Deck Auxiliaries. C. F. A. Fyfe. A report of observations made to find how much steam marine auxiliaries use when doing ordinary work in port, and to frame a method of predicting the water consumption at sea for purposes other than the main engines. 6000 w. Inst of Engrs & Shipbldrs in Scotland—March 22, 1910. No. 19773 N.

**Yachts.**

The Yacht "Mohawk." Illustrated detailed description of a yacht designed by R. E. Barry for cruising single-handed along the Atlantic Coast. 2500 w. Engng—Dec. 16, 1910. No. 19594 A.

# MECHANICAL ENGINEERING

## AERONAUTICS.

**Aeroplane Construction.**

Iron and Wood (Eisen und Holz). G. Ewerding. Discusses mathematically the reinforcement of wood with iron for use in aeroplane construction. Ills. Serial. 1st part. 1100 w. Motorwagen—Nov. 10, 1910. No. 19805 D.

See also Alloys, under MATERIALS OF CONSTRUCTION.

**Aeroplanes.**

The First Marine Aeroplane. Illustrated description of the Fabre hydro-aeroplane. 1500 w. Sci Am—Dec. 17, 1910. No. 19364.

**Aeroplane Stability.**

A Device to Increase the Stability of Aeroplanes (Stabilisationsautomat für Flugmaschinen). Seb. Volz. Describes a device invented by the author. Ills. 2000 w. Motorwagen—Nov. 30, 1910. No. 19807 D.

**Airship Flights.**

The Willows Dirigible Airship. Illustrations, with an account of a flight from London to France during the night. 1200 w. Sci Am Sup—Dec. 3, 1910. No. 19103.

**Altitude.**

Determining the Height of Aeroplanes. Commandant Renard. Explains various methods of determining altitude. 2800 w. Sic Am Sup—Dec. 24, 1910. No. 19493.

How Altitude Records Are Made. Illustrates and describes remarkable soarings, and the methods of using the barograph. 1800 w. Sci Am Sup—Dec. 24, 1910. No. 19489.

**Balloons.**

A Discussion of the War Balloon and Similar Craft, and the Best Methods of Attack by Artillery. Walter E. Prosser. 2200 w. Jour U S Art—Nov.-Dec., 1910. No. 19551 D.

In the Building of Balloons. William B. Ennis. First of a series of articles discussing problems to be solved. Considers aerial statics, and methods for altitude control in the present number. Ills. 2000 w. Automobile—Dec. 22, 1910. Serial. 1st part. No. 19509.

**Competitions.**

The Milan Aviation Meet (Il Circuito Aereo di Milano). Describes the aerodrome, the competing machines, and the results at the Milan, 1910, meet. Ills. Serial. 1st part. 2000 w. Industria—Nov. 13, 1910. No. 19656 D.

**Motors.**

Six Aviation Engines. Brief descriptions of the aeronautical motors entered for the Alexander prize competition. 1800 w. Sci Am Sup—Dec. 17, 1910. No. 19367.

## AUTOMOBILES.

**Agricultural Machinery.**

Motor Driven Plow and Cultivator. H. E. Miller. Illustrated description of a Swiss machine said to have proved successful. 1500 w. Sci Am—Dec. 3, 1910. No. 19101.

The Bajac Motor Plow (Le Tracteur-Treuil de M. A. Bajac). Max Ringelmann. Describes the machine and reports tests. Ills. 3200 w. Bul Soc d'Encour—Nov., 1910. No. 19627 G.

**Brakes.**

Front Wheel Braking. William Paddon. Gives conclusion after 1500 miles road usage. 1600 w. Autocar—Nov. 26, 1910. No. 19174 A.

Front-Wheel Brakes. Reviews the subject, explaining the advantages and disadvantages, the principles and their application. 2500 w. Auto Jour—Nov. 26. 1910. Serial. 1st part. No. 19170 A.

Modern Motor Car Brakes—Practical Calculations. F. E. Watts. Discusses the practical calculation of the holding power of brakes. Ills. 2200 w. Horseless Age—Nov. 30, 1910. No. 19140.

*We supply copies of these articles. See page 839.*

**Carburetters.**

A Constant Vacuum Carburetter. W. Bourne Dale. Sectional drawing, with description by the designer. 2000 w Autocar—Nov. 26, 1910. No. 19173 A.

**Commercial Vehicles.**

The Sheppee Convertible Steam Motor-Vehicle. Plate, with illustrated detailed description of a vehicle with two interchangeable bodies. 1500 w. Engng—Dec. 2, 1910. No. 19326 A.

The Schneider Motor Truck for Rock Transport (Binard Automobile, Système Schneider, pour le Transport des Pierres de Taille). Brief description. Ills. 2200 w. Génie Civil—Nov. 19, 1910. No. 19642 D.

The Economics of Commercial Vehicles (Zur Rentabilitätsfrage von Motorlastwagenbetrieben). W. Schwerdtfeger. A discussion of first and operating costs, maintenance, depreciation, etc., and of methods of calculation. Ills. Serial. 1st part. 3000 w. Zeitschr d Mit Motorwagen Ver—Nov. 15, 1910. No. 19803 D.

See also Skidding, under AUTOMOBILES.

**Construction.**

The Structural Engineering of Motor Cars. John L. Milligan. Abstract of a paper read before the Manchester Assn. of Engrs. Deals only with pleasure cars, discussing the design, arrangement of machinery, etc. Ills. 3000 w. Mech Engr—Dec. 16, 1910. No. 19588 A.

**Daimler.**

The 16-18 H. P. Austrian-Daimler Chassis. Illustrated detailed description. 1500 w. Auto Jour—Nov. 26, 1910. No. 19171 A.

**Design.**

Calculation of an Automobile Rear System. Karl Feilcke. Shows how the dimensions are determined. The present installment covers the axle shafts, driving and differential gears, and the bearings. 2000 w. Horseless Age—Dec. 14, 1910. Serial. 1st part. No. 19403.

**Electric.**

Storage Batteries for Heavy Traction. Newton Harrison. Explains the requirements, discusses types of storage cells, and other features of the problem. 3000 w. Cent Sta—Dec., 1910. No. 19279.

See also Garages, under AUTOMOBILES.

**Exhibitions.**

The Paris Salon. Illustrates and describes the exhibits, showing Continental designs and tendencies. 3000 w. Autocar—Dec. 10, 1910. No. 19416 A.

The Smithfield Club Show. Illustrates and describes some tractors, and a gas-engine shown, with notes on other exhibits. 2500 w. Engng—Dec. 9, 1910. No. 19445 A.

**Fire Engines.**

The Practical Use of the Automobile Fire Engine as a Fire-Fighting Apparatus. Charles S. Allen. Read before the Intnat. Assn. of Fire Engrs. Considers problems of construction, the advantages over the horse-drawn apparatus, costs etc. 2000 w. Can Engr—Dec. 15, 1910. No. 19405.

**Garages.**

The Proper Garaging of Electric Vehicles. C. L. Morgan. Explains a system for obtaining satisfactory results, and the conditions that would make its application advisable. 2500 w. Cent Sta—Dec., 1910. No. 19281.

**Germain.**

The 15 H. P. Germain. Illustrates and describes the chassis, the unique engine design, overhead valves and camshaft, with silent chain drive. 1200 w. Autocar—Dec. 3, 1910. No. 19309 A.

**Ignition.**

An Elementary Explanation of Magneto Action. P. M. Heldt. Illustrates and describes the individual parts and their functions. 3500 w. Horseless Age—Nov. 30, 1910. No. 19142.

A Low-Tension Ignition Revival. Illustrated detailed description of the "Hilo" low-tension system. 2500 w. Auto Jour—Dec. 17, 1910. No. 19576 A.

**Industry.**

American Competition (Amerikanische Gefahr). Adolf Schreiber. Discusses the possibility of the competition of American automobiles with Continental models. Ills. 2800 w. Motorwagen—Nov. 10, 1910. No 19804 D.

**Laboratories.**

Making the Laboratory Pay. Illustrates and describes features of the laboratory of the E. R. Thomas Co., at Buffalo, and some of the work carried out. 3000 w. Automobile—Dec. 1, 1910. No. 19062.

**Locomobile.**

Two 1911 Locomobile Models—30 and 48 Horse Power. Illustrated descriptions, calling attention to new features. 2000 w. Horseless Age—Nov. 30, 1910. No. 19143

**Materials.**

Alloy Steel Tubing for the Automobile Industry. Joseph Schaeffers. Describes a new material of construction for hollow or annular parts which promises a considerable saving in manufacturing cost. 1000 w. Horseless Age—Dec. 7, 1910. No. 19252.

See also Alloy Steels, under MATERIALS OF CONSTRUCTION.

**Motor Cooling.**

Precautions to Be Taken Against Freezing. H. F. Donaldson. Explains mechanical and chemical methods of preventing damage to gas-motor water cooling systems. 1200 w. Com Veh—Dec. 1910. No. 19167 C.

**Motor Cycles.**

Motor Cycles at Olympia. Illustrations and brief descriptions of cycles exhibited. 1500 w. Auto Jour—Nov. 26, 1910. No. 19172 A.

*We supply copies of these articles. See page 839.*

**Motor Pistons.**

Pistons for Petrol-Motors. Shows the importance of lightness of pistons in petrol-motors and discusses methods of securing it. Ills. 3000 w. Engng—Dec. 16, 1910. No. 19593 A.

**Motor Power.**

Simple Power-Measurement on Motor Cars. H. E. Wimperis. Read before the British Assn. On the use of the author's accelerometer. Ills. 1800 w. Auto Jour—Dec. 3, 1910. Serial. 1st part. No. 19311 A.

**Motors.**

A New Two-Cycle Engine. Illustrates and describes an internal combustion motor without camshafts, valves, or timing gear. 2500 w. Autocar—Nov. 26, 1910. No. 19175 A.

The Knight Motor (Le Moteur Knight). M. de Fréminville. Describes the Knight type of automobile motor and examines its advantages and defects. Ills. 4500 w. Bul Soc d'Encour—Nov., 1910. No. 19630 G.

**Motor Troubles.**

The "Gas" Knock. Albert L. Clough. Discusses the theory and gives a plausible explanation. 1200 w. Horseless Age—Nov. 30, 1910. No. 19141.

**Motor Valves.**

Indirect Valve Operation—Pneumatically Operated Valves. Eugene P. Batzell. A discussion of the effect on motor power of operating motor valves by air pressure or vacuum and the change in valve timing with variations in motor speed. Ills. 6000 w. Horseless Age—Dec. 7, 1910. No. 19251.

**Napier.**

The 65-H. P. 6-Cyl. Napier. Illustrations and brief description of the interesting features of the chassis. 600 w. Auto Jour—Dec. 3, 1910. No. 19310 A.

**Omnibuses.**

See Paris, under STREET AND ELECTRIC RAILWAYS.

**S. C. A. R.**

The S. C. A. R. Illustrates and describes details of construction of this runabout car. 1000 w. Auto Jour—Dec. 10, 1910. No. 19415 A.

**Skidding.**

Preventing Skids and Slips in Commercial Vehicle operation. Illustrates and describes devices being tried. 1500 w. Horseless Age—Dec. 21, 1910. No. 19506.

**Tires.**

Effect of Speed on Tire Wear. Albert L. Clough. Shows that the destructive effect increases with the speed. 1500 w. Horseless Age. Dec. 21, 1910. No. 19505.

**Traffic.**

The Development of Road Locomotion in Recent Years. L. A. Legros. Deals particularly with development in Great Britain since 1900. 9000 w. Inst of Mech Engrs—Nov. 18, 1910. 19187 N.

**Wheels.**

The Lynton Wheel and Tyre. Illustrates and describes types of this wheel and the action. 1500 w. Auto Jour—Dec. 17, 1910. No. 19577 A.

**Winter Storage.**

Laying Car Up for Winter. Describes how each part should be treated. Ills. 1200 w. Automobile—Dec. 1, 1910. No. 19063.

## COMBUSTION MOTORS.

**Fuel Leakage.**

The Detection of Petroleum Vapor or Gas. John H. Heck. Read before the Inst of Engrs. & Shipbldrs. in Scotland. Describes an improved test for detecting the presence of the vapor or gas. 2200 w. Mech Engr—Dec. 9, 1910. No. 19435 A.

**Gas Engines.**

The Côte Two-Cycle Engine (Un Moteur à deux Temps de M. Côte). E. Sauvage. Brief illustrated description of a simple type of two-cycle engine. Ills. 1000 w. Bul Soc d'Encour—Nov., 1910. No. 19628 G.

**Gas Power Plants.**

Gas Power Plant Costs. R. S. Manning. Gives tabulated installation costs of a large gas-driven station in Wisconsin. 600 w. Power—Dec. 6, 1910. No. 19139.

Performance of a Gas Power Plant Using Lignite. A. M. Levin. Describes the performance of a twin single-acting engine running on lignite gas at Turnwater, Wash. 2200 w. Power—Dec. 27, 1910. No. 19574.

**Gas Producers.**

Notes on a Heavy-Duty Gas Producer. Nisbet Latta. Reports experiments, describing and illustrating apparatus used. 2000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19069 F.

**Oil Engines.**

600-Horse-Power Diesel Engine. Plate and description of an engine shown in the Dutch Section at the Brussels Exhibition. 1000 w. Engng—Nov. 25, 1910. No. 19191 A.

Power and Fuel-Consumption Tests of a 5 Horse Power, High-Speed, Crude-Oil Diesel Engine (Leistungs- und Verbrauchsversuche an einem schnellaufenden Rohöl-Kleinmotor von 5 PS, gebaut von Diesel & Co.). F. Romberg. Describes the motor and the tests and gives results. Ills. 3800 w. Zeitschr d Ver Deutscher Ing—Nov. 5, 1910. No. 19836 D.

**Producer Gas.**

Determination of the Calorific Value and of Operating Conditions from Analysis of Industrial Gases. J. M. Morehead. Read before the Am. Gas Inst. Explains the method of gas analysis and what it shows, illustrating apparatus used. 5000 w. Am Gas Lgt Jour—Dec. 12, 1910. Serial. 1st part. No. 19265.

**Testing.**

See Manograph, under MEASUREMENT.

## HEATING AND COOLING.

**Air Purification.**

Present Status of Ozone With Reference to Air Purification. Ralph D. Small. Address before the Am. Electro-Chem. Soc. Information concerning its production and use. 3500 w. Heat & Vent Mag—Dec., 1910. No. 19554.

**Central Station.**

See Economics, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

**Electric Heating.**

See Heating, under ELECTRICAL ENGINEERING, POWER APPLICATIONS.

**Heating Requirements.**

Estimating Heating Requirements. Reginald P. Bolton. Excerpt from a paper read before the Assn. of Edison Ill. Co.'s. Presents a method including the loss by infiltrations. 2500 w. Power—Dec. 27, 1910. No. 19573.

**Hot-Water Heating.**

Indirect Hot-Water Residence Heating. Plans and description of a combination direct and indirect hot-water system. 900 w. Met Work—Dec. 24, 1910. No. 19557.

Furnace Heating of a New Haven Church. Describes the use of two furnaces with out-door air connection and one for rotary air circulation. Ills. 1800 w. Met Work—Dec. 3, 1910. No. 19119.

Mechanical Furnace Heating of a Church. An interesting system installed in the Presbyterian Church at Laurens, S. C., is described. An electrically driven fan forces air over furnace, and the air is rotated when the building is not occupied. 2000 w. Met Work—Dec. 17, 1910. No. 19379.

Recent Progress in Heating Practice (Mitteilungen aus der neueren Heizungstechnik). Joh. Körting. Describes recent developments in furnace, hot-water, and steam heating practice and apparatus. Ills. 4200 w. Zeitschr d Ver Deutscher Ing—Nov. 19, 1910. No. 19842 D.

**Hot-Water Piping.**

Corrosion of Hot-Water Piping in Bath-Houses. Ira H. Woolson. Reports results of investigations made. 1800 w. Eng News—Dec. 8, 1910. No. 19238.

**Refrigeration.**

Pressures in Refrigerating System. F. E. Matthews. Data on temperature and pressures and their relations. 1500 w. Power—Dec. 13, 1910. No. 19289.

Exhaust Steam Ice-Making Plant. Illustrated description of a recent installation of machinery for the ammonia absorption system. 1000 w. Engr, Lond—Dec. 2, 1910. No. 19335 A.

Operating Notes on Refrigeration. F. E. Matthews. Discusses the defrosting of brine and direct-expansion coils, removal of oil and gases, and the effect of incrustation. 2500 w. Power—Dec. 6, 1910. No. 19136.

The Possibility of Applying Centrifugal Compressors to Compression in Refrigeration (Die Möglichkeit der Verwendung von Kreiselgebläsen als Kühlmaschinen-Verdichter). Hans Lorenz. Read at the Second International Congress of the Cold. Ills. 2200 w. Zeitschr f d Gesamte Turbinenwesen—Nov. 30, 1910. No. 19801 D.

The Audiffren Refrigerating System and Small-Scale Refrigeration (I Frigorigeni Audiffren e la Piccola Industria del Freddo). Francesco Mauro. A detailed description of the system and its use in small units. Ills. 2100 w. Monit Tech—Nov. 10, 1910. No. 19652 D.

The Second International Congress of the Cold (IIe Congrès International du Froid, Vienne, 6-12 Octobre 1910). E. Lemaire. Gives a resume of the papers read at the recent Vienna Congress. Serial. 1st part. 3500 w. Génie Civil—Nov. 12, 1910. No. 19641 D.

**Ventilation.**

The Air We Breathe. William E. Watt. Discusses how vitality comes from the air and what deteriorates it. 2500 w. Dom Engng—Dec. 17, 1910. No. 19396.

Ventilation Troubles in School Buildings. W. A. Evans. Discusses troubles and remedies with special reference to the Chicago schools. 1600 w. Heat & Vent Mag—Dec., 1910. No. 19555.

The Vicious Quatitative Standard in Ventilation. William Henry Lynch. A discussion of the limit of present knowledge of ventilation, arguing that any standardization at the present time would be standardizing ignorance. 4500 w. Dom Engng—Dec. 17, 1910. No. 19397.

## HYDRAULIC MACHINERY.

**Centrifugal Pumps.**

The Design of Centrifugal Pumps. James A. Seager. Illustrates and describes features of interest in recent English designs. 1200 w. Eng & Min Jour—Dec. 17, 1910. No. 19395.

**Laboratories.**

Our Hydraulic Laboratory. E. W. Schoder. Illustrated description of the Cornell hydraulic laboratory as it is today. 800 w. Cornell Civ Engr—Dec., 1910. No. 19529 C.

**Penstocks.**

See Pipe Friction, under HYDRAULIC MACHINERY.

**Pipe Friction.**

A Friction Head Diagram for Riveted Steel Pipes or Penstocks. Irving P. Church. Gives a diagram on a logarithmic basis, with explanation. 500 w. Cornell Civ Engr—Dec., 1910. No. 19528 C.

**Pipe-Line Surges.**

Surges in Pipe Lines. F. G. Baum. Reviews briefly electrical surge phenomena as explained in an earlier paper, and applies the reasoning to pipe lines. Dia-

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grams. 2000 w. Elec Wld—Dec. 8, 1910. No. 19228.

**Presses.**

See Hydraulic Presses, under MACHINE ELEMENTS AND DESIGN.

**Pumping.**

The Economical Pumping of Deep Wells. B. C. Sloat Read at the convention of the Eastern Ice Assn. Considers the three types of deep well pumps. Short discussion. 3000 w. Ice & Refrig—Dec., 1910. No. 19258 C.

**Pumping Engines.**

Report of Dutv Trial on the Six Million Imperial Gallon Pumping Engine at the High Level Pumping Station, Toronto Water Works. Robert W. Angus. Ills. 4500 w. Ap Sci—Dec., 1910. No. 19727 C.

**Pumping Plants.**

An Electrically Operated Municipal Pumping Station. Alexander J. Lindsay. Illustrated description of an electrically operated pumping station for increasing the supply at Spokane, Wash. 2500 w. Eng Rec—Dec. 10, 1910. No. 19271.

The Development of the Municipal Water-Works of Spokane, Wash., and the Addition of an Electric Pumping Station. Alexander J. Lindsay. Illustrated description of the new electric pumping station, made necessary by the rapid growth of the city. 2500 w. Eng News—Dec. 8, 1910. No. 19237.

**Pump Priming.**

Means for Priming Pumps. Illustrated description of a device, operating by exhausting air or gas, which is brought into use whenever the pump requires priming. 1200 w. Prac Engr—Dec. 2, 1910. No. 19317 A.

**Rams.**

Improvements in Hydraulic Rams. Illustrates and describes improvements invented by B. McIntire, of San Salvador. 2500 w. Prac Engr—Dec. 16, 1910. No. 19583 A.

**Shears.**

See Plate Shears, under MINING AND METALLURGY, IRON AND STEEL.

**Turbine Nozzles.**

Swinging Nozzles (Schwenkdüsen, ihre Konstruktion und ihre Aufgaben). Herr Kröner. Describes the Henry, Doble, de Wein, Warren and Zodel types. 2400 w. Die Turbine—Nov. 20, 1910. No. 19697 D.

**Turbines.**

Turbines of Increased Capacity at Niagara Falls, Ont. Illustrated description of an interesting water turbine recently designed and installed by the Canadian Niagara River Co. 700 w. Elec Wld—Dec. 29, 1910. No. 19785.

An Elementary Treatment of Lorenz' Turbine Theory (Elementare Behandlung der Lorenzschen Theorie der Kreiselräder). Felix Langen. Mathematical. Ills. 2500 w. Zeitschr f d Gesamte Turbinenwesen—Nov. 30, 1910. No. 19802 D.

**Turbine Screens.**

The Flow of Water Through Submerged Screens. Extracts from a thesis by Henry Ryon. An investigation confined to a slat screen with different conditions of pointing and a perforated screen with two different spacings of openings. Ills. 1000 w. Cornell Civ Engr—Dec., 1910. No. 19527 C.

**Water Hammer.**

A Short Method of Calculating Water Hammer in Pipe Lines of Moderate Length (Sul Calcolo Abbreviato del Colpo d'Ariete nelle Condotte di Moderata Lunghezza). P. Alibrandi. Mathematical demonstration. 2100 w. Ann d Soc d Ing e d Arch Ital—Oct. 1, 1910. No. 19646 F.

**Water-Wheel Governors.**

Water Wheel Governors. E. R. Frost. Considers conditions affecting regulation and describes types of governors. Ills. 3000 w. Ap Sci—Dec., 1910. No. 19726 C.

## MACHINE ELEMENTS AND DESIGN.

**Balancing.**

The Balancing of Machine Elements (De l'Equilibrage des Organes mécaniques). R. Filloche and Georges Lévy. A detailed study of static and dynamic equilibrium, and of the theory and practice of balancing machine parts. Ills. Serial. 1st part. 3500 w. Tech Mod—Nov., 1910. No. 19620 D.

**Ball Bearings.**

Ball-Bearing Tests (Ueber Versuche mit Kugellagern). F. Symanzik. Deals with many points in ball-bearings practice based on test results. Ills. Serial. 1st part. 2200 w. Motorwagen—Nov. 20, 1910. No. 19806 D.

**Clutches.**

See Disc Friction, under MACHINE ELEMENTS AND DESIGN.

**Disc Friction.**

A Problem in Disk Friction. John S. Myers. Presents a problem in connection with a disk friction clutch which suggests the development of a new theory for arriving at the ideal compromise in machine design. 1800 w. Mach, N Y—Dec., 1910. No. 19110 C.

**Drafting Rooms.**

See Illumination, under ELECTRICAL ENGINEERING, LIGHTING.

**Flywheels.**

A Graphical Method for the Design of Flywheels (Notes sur une Méthode Graphique pour le Calcul des Volants). C. Colombi. A mathematical and graphical demonstration of the method. Ills. 2000 w. Rev de Mécan—Nov., 1910. No. 19636 E. + F.

**Gears.**

Analysis of Velocity Ratios of Epicyclic Gear Trains. A. Lewis Jenkins. Explains various methods of analysis. Ills. 4000 w. Eng News—Dec. 8, 1910. No. 19234.

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**Gyroscope.**

The Gyroscope and Its Useful Possibilities. Elmer A. Sperry. An illustrated explanation of its phenomena is given in the present number, and later articles will review the work of experimenters and the author's development. 3000 w. Ir Age—Dec. 1, 1910. Serial. 1st part. No. 19040.

The Theory of the Gyroscope (Zur Theorie des Kreisels). Th. Rosenbaum. Discusses its principles and technical applications. Ills. 7000 w. Schiffbau—Nov. 23, 1910. No. 19687 D.

The Couple which Produces the Tendency to Parallelism in the Axes of the Gyroscope (Note sur le Couple qui Produit, dans le Gyroscope, la "Tendance des Axes au Parallélisme"). H. Janne. A mathematical treatment of the theory of the gyroscope. Ills. Serial. 1st part. 3300 w. Bul Sci d l'Assn d Eleves—Nov., 1910. No. 19626 D.

**Hydraulic Presses.**

Design of Hydraulic Press Rams. A. Lewis Jenkins. A study of the stresses produced by eccentric loading. 2000 w. Am Mach—Vol. 33. No. 49. No. 19214.

**Shafts.**

Critical Speeds for Torsional and Longitudinal Vibrations. Arthur Morley. A mathematical determination of the torsional vibrations in shafts. 2500 w. Engng—Dec. 9, 1910. No. 19440 A.

## MACHINE WORKS AND FOUNDRIES.

**Aluminum Founding.**

Foundry Operations on an Aluminum Gear Case Casting. Illustrates and describes work on an automobile gear case. 800 w. Castings—Dec., 1910. No. 19399.

**Automatic Machines.**

Cutting Keyways in an Automatic Screw Machine. S. N. Bacon. Describes the work. Ills. 1200 w. Mach, N Y—Dec., 1910. No. 19109 C.

See also Lathes, under MACHINE WORKS AND FOUNDRIES.

**Brass Founding.**

Brass Foundry Costs and Statistics. Charles R. Stevenson. Considers methods by which actual costs can be obtained. 4000 w. Am Brass Found Assn—1910. No. 19010 N.

The Selling of Brass Foundry Refuse. Jesse L. Jones. Discusses methods of disposing of foundry scrap. 2000 w. Am Brass Found Assn—1910. No. 19012 N.

Fluxes as Applied to the Brass Foundry. Erwin S. Sperry. Describes fluxes that time has proved valuable and the manner in which they should be used. 3000 w. Am Brass Found Assn—1910. No. 19013 N.

Gating and Casting Large Bronze Rings. C. Vickers. Illustrates and describes methods used. 1000 w. Foundry—Dec., 1910. No. 19161.

See also Pattern Making, under MACHINE WORKS AND FOUNDRIES; and Lead Assaying, under MINING AND METALLURGY, LEAD AND ZINC.

**Case Hardening.**

The Case Hardening and Heat Treatment of Low Carbon Steels. A. C. Sladky and A. F. Schultz. Abstract of a thesis. Reports experiments which show that heat treatment and case-hardening greatly benefit the strength of steel both under static and live loads. Ills. 1000 w. Wis Engr—Dec., 1910. No. 19516 C.

**Copper Founding.**

See Copper, under MATERIALS OF CONSTRUCTION.

**Cupolas.**

Making a Small Cupola. Walter J. May. Drawings and description. 1000 w. Mech Wld—Dec. 9, 1910. No. 19437 A.

**Drilling Machines.**

A New Radial Drilling Machine. Illustrates and describes a new design by Loudon Brothers, in which all adjustments of the tool can be operated from the saddle. 1200 w. Engr, Lond—Dec. 2, 1910. No. 19336 A.

**Forging.**

Tools and Dies for Drop Forging. E. F. Lake. Illustrates and describes the tools and dies and the forgings made, showing the variety of work. 1800 w. Am Mach—Vol. 33. No. 50. No. 19348.

**Foundries.**

The New Hartung Foundry at Berlin-Lichtenberg (Neue Giesserei-Anlage der Hartung Akt.-Ges. in Berlin-Lichtenberg). Th. Ehrhardt. Describes an installation embodying the most modern practice in foundry design. Ills. 3800 w. Stahl u Eisen—Nov. 9, 1910. No. 19666 D.

**Foundry Coke.**

The Coke Industry of the United States as Related to the Foundry. Richard Moldenke. Reviews the coke industry, features of practice in the use of coke in the foundry, the probable processes of a cupola heat, and the reasons for modifying practice so that a particular coke can be used to advantage. 11000 w. U S Bureau of Mines—Bul. 3. No. 19525 N.

**Foundry Design.**

Typical Modern Foundry Layouts. H. Cole Estep. Plans and description of the arrangement and equipment of gray iron foundries of varying capacities. 800 w. Minn Engr—Nov., 1910. No. 19759 C.

**Foundry Furnaces.**

Electric Power Required to Melt Metals. Joseph W. Richards. Considers the proper basis for information in this field. 1500 w. Am Brass Found Assn—1910. No. 19015 N.

The New Rockwell Tilting Furnace. Illustrated description of a furnace pouring directly into molds without crucible or ladle. 900 w. Ir Age—Dec. 29, 1910. No. 19776.

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**Foundry Lighting.**

Lighting a large Iron Foundry. G. H. Stickney. Considers illumination for molding and pouring, reporting tests made. 2000 w. Am Mach—Vol. 33. No. 48. No. 19044.

**Foundry Materials.**

See Ferro-Alloys, under MINING AND METALLURGY, IRON AND STEEL.

**Foundry Practice.**

Use of Vanadium in Steel Castings. Illustrated description of methods of molding and casting vanadium steel employed by the Union Steel Casting Co., Pittsburg. 1400 w. Foundry—Dec., 1910. No. 19158.

The Production of Cast Steel in the Converter (Konverter-Stahlguss). J. Holicky. A brief description of the Tropenas process. Ills. Serial. 1st part. 1500 w. Giesserei-Zeit—Nov. 15, 1910. No. 19678 D.

**Furnaces.**

Producer and Water Gas for Furnaces. L. B. Lent. Information on which to base a calculation as to whether it will be profitable to install and use gas made from solid fuel. 3300 w. Am Mach—Vol. 33. No. 49. No. 19213.

**Gear Cutting.**

Involute Cut-Gearing. S. H. Rowley. Discusses present results and practices adopted for its production. Ills. 2500 w. Mech Engr—Dec. 2, 1910. Serial. 1st part. No. 19320 A.

**Grinding.**

The Field for Grinding. C. H. Norton. An illustrated account of results attained by the use of the modern grinding machine and grinding wheel. 2500 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19072 F.

Modern Grinding Methods. B. M. W. Hanson. Illustrated discussion of recent improvements to grinding machines and devices used to control the work. 2000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19074 F.

Precision Grinding. W. A. Viall. Considers the possibilities of grinding and things that must receive attention to make the work a mechanical and financial success. 2000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19073 F.

**Lathes.**

Manufacturing on the Engine Lathe. H. M. Wood. Describes a development in machine design which enables repetition work to be produced rapidly upon an engine lathe. Ills. 1200 w. Am Mach—Vol. 33. No. 48. No. 19045.

Slotting-Machines and Capstan Lathes. Illustrated detailed description of machine tools made at Lupton, Eng. 2000 w. Engng—Dec. 9, 1910. No. 19441 A.

English 24-Inch Lathe. W. H. Haggas. Illustrated description of an interesting modern design. 900 w. Mach, N Y—Dec., 1910. No. 19105 C.

**Machine Tools.**

Clamping and Locking Devices Applied to Machine Tools. Joseph G. Horner. Illustrates and describes typical devices, showing American, English, and German practice. 2500 w. Mach (Ry Ed)—Dec., 1910. No. 19294 C.

See also Safety Devices, under MISCELLANY.

**Metal Finishes.**

The Bradley Rust-Proof Black Finish for Iron and Steel and the Method of Producing It. An illustrated description of this process. 1000 w. Brass Wld—Dec., 1910. No. 19497.

**Milling Machines.**

A New Plain Milling Machine. Illustrated detailed description of the Brown & Sharpe No. 13 B constant speed type. 1000 w. Ir Age—Dec. 29, 1910. No. 19774.

**Molding.**

Molding Branch Pipes in Dry Sand. Howard C. Deysher. Illustrated description of the work. 1000 w. Foundry—Dec., 1910. No. 19159.

**Molding Sand.**

The Preparation of Molding Sand (Ein Streifzug durch das Gebiet der Formsandaufbereitung). E. Bauer. A general discussion of the subject. Serial. 1st part. 2400 w. Giesserei-Zeit—Nov. 1, 1910. No. 19677 D.

Magnetic Separation in the Foundry (Elektromagnetische Eisenseparatoren im Giessereibetriebe). Erich Oppen. Describes a number of apparatus for removing particles of iron from molding sand. Ills. 2600 w. Stahl u Eisen—Nov. 9, 1910. No. 19667 D.

**Molding Machines.**

Molding Machines, Stripping-plates, and arranging Patterns. R. H. Palmer. Discusses ways of using molding-machines and the apparatus necessary for their proper handling. 2500 w. Castings—Dec., 1910. No. 19401.

**Pattern Making.**

Making Patterns for Brass Valves. Frank B. Lucas. Describes method for castings made in quantities. Ills. 2000 w. Foundry—Dec., 1910. No. 19163.

See also Woodworking Machines, under MACHINE WORKS AND FOUNDRIES.

**Patterns.**

Pattern and Mold of a Valve for Pumping Engine. John Williams. Illustrated description of foundry work on a valve. 1200 w. Castings—Dec., 1910. No. 19400.

Making Patterns from Oiled Sand. Illustrates and describes a new method and new material for pattern making, used in making injectors. 1700 w. Am Mach—Vol. 33. No. 49. No. 19210.

The Utility of the Skeleton Pattern. J. R. Moorhouse. Methods of making skeleton patterns are explained and their

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economy and scope. Ills. 2200 w. Foundry—Dec., 1910. No. 19160.

**Screw Cutting.**

Cutting Fractional Screw Threads. Martin H. Ball. Gives tables, with explanation of their use. 800 w. Mach, N Y—Dec., 1910. No. 19108 C.

**Sheet-Metal Working.**

Manufacturing an Accurate Pawl. A. C. Lindholm. Explains troubles encountered, which were overcome by making the pawls on the punch press from sheet metal. Ills. 1000 w. Am Mach—Vol. 33. No. 40. No. 19347.

**Shop Appliances.**

Tools at the Springfield Armory. S. B. Redfield. Illustrates and describes interesting special tools and dies. 2500 w. Am Mach—Vol. 33. No. 48. No. 19043.

**Shop Design.**

Modern Machine Shops and Industrial Plants. Charles Day. A descriptive analysis of various typical plants. Ills. 3000 w. Engineering Magazine—Jan., 1911. No. 19743 B.

Efficient Departmental Arrangement. Oscar E. Perrigo. Discusses the planning of a manufacturing plant to secure maximum results with highest economy. 3300 w. Ir Trd Rev—Dec. 29, 1910. No. 19778.

Rearrangement of Machine Tools; Union Pacific Locomotive Shop, Omaha, Neb. Gives plate, and describes the new shop layout. 700 w. Ry Age Gaz—Dec. 2, 1910. No. 19118.

**Shop Practice.**

The Hammer and Chisel. James Stormonth. Suggestions for the proper use of these tools. 2000 w. Mech Wld—Dec. 2, 1910. No. 19321 A.

Some Hints on Lining-Out. Fred Horner. On the importance of this work, with suggestions. 1500 w. Mech Wld—Dec. 9, 1910. Serial. 1st part. No. 19436 A.

Shop Kinks. F. E. Lister. Illustrates and describes interesting methods used in the Lehigh Valley shops at Sayre, Pa. 6000 w. Ry Age Gaz—Dec. 2, 1910. No. 19116.

**Shops.**

The Telephone Works of the Western Electric Co., Ltd., Woolwich. Illustrated description of the apparatus factory, with particulars of the plant and methods of organization. 2500 w. Elec Rev, Lond—Dec. 16, 1910. No. 19580 A.

The New Shops of the Bechem & Keetman Works of the Deutscher Maschinenfabrik A. G., Duisburg, Germany (Die Neuanlagen der Deutschen Maschinenfabrik A. G., Werk Bechem & Keetman in Duisburg). Describes an extensive modern plant for the manufacture of heavy machinery. Ills. Serial. 1st part. 3600 w. Stahl u Eisen—Nov. 30, 1910. No. 19676 D.

**Shop Ventilation.**

The Determination of Impurities in Factory Air (L'Aria degli Ambienti Industriali e le Misurazioni degli Inquinamenti). Discusses particularly the researches of Henriet. 2000 w. Monit Tech—Oct. 30, 1910. No. 19650 D.

**Slotters.**

See Lathes, under MACHINE WORKS AND FOUNDRIES.

**Tool Rooms.**

A Large Tool-Room and Its System. Franklin D. Jones. Illustrates and describes methods employed in the tool-making department of the Taft-Peirce Mfg. Co. 2500 w. Mach, N Y—Dec., 1910. No. 19107 C.

**Welding.**

Electrically Welded Vehicle Wheels. Illustrates and describes methods of manufacturing light, strong, steel wheels for small vehicles, which are put together in electric welding machines. 1500 w. Am Mach—Vol. 33. No. 48. No. 19042.

The Development of Autogenous Welding and of Autogenous-Welding Apparatus (Zur Entwicklung der autogenen Metallbearbeitung und der hierzu notwendigen Betriebsmittel). August Bauschlicher. A review of the recent developments in this field. Ills. 5500 w. Zeitschr f Werkzeug—Nov. 25, 1910. No. 19817 D.

Autogenous Welding and Metal Cutting by Means of Oxygen (La Soudure autogène et le Coupage a l'Oxygène). A review of recent literature. 2500 w. Rev d'Econ Indus—Nov. 20, 1910. No. 19625 D.

**Woodworking Machines.**

A Wood Milling Machine. A. N. Spencer. Illustrated description of the Wadkin mechanical woodworker, made in England, and its use in pattern making. 2500 w. Am Found Assn—1910. No. 19007 N.

## MATERIALS OF CONSTRUCTION.

**Alloys.**

Light-Weight Alloys for Aeroplanes. Information concerning these alloys. 2000 w. Foundry—Dec., 1910. No. 19162.

Some Alloys for Permanent Magnets. C. F. Burgess and James Aston. A record of tests in carbon-free alloys. 3000 w. Met & Chem Engng—Dec., 1910. No. 19302 C.

Alloys of Nickel and Cobalt with Chromium. Elwood Haynes. Read before the Am. Chem. Soc. Describes experimental work and the results. 3000 w. Jour of Worcester Poly Inst—Nov., 1910. No. 19018 C.

**Alloy Steels.**

The Selection and Treatment of Alloy Steels for Automobiles. Henry Souther. Treats of various kinds of alloy steels and their applications in the automobile indus-

try. 5000 w. Jour Fr Inst—Dec., 1910. No. 19719 D.

Manganese Steel. F. E. Johnson. Information concerning this material and its characteristics, its manufacture and uses. 3000 w. Jour Assn of Engng Socs —Nov., 1910. No. 19723 C.

Manganese Steel. J. F. Springer. An illustrated article on the manufacture and applications of a special alloy steel. 8000 w. Cassier's Mag—Dec., 1910. No. 19538 B.

See also Materials, under AUTOMOBILES; and Foundry Practice, under MACHINE WORKS AND FOUNDRIES.

**Bearing Metals.**

Bearing Metals, or Anti-Friction Alloys. A Napier. From *Foundry Trade Jour.* Notes on the qualities and composition of bronzes for bearings, white antifriction alloys, etc. 2000 w. Mech Wld —Dec. 16, 1910. No. 19590 A.

An Investigation of Bearing Metals. H. B. McDermid. Describes investigations to determine whether the cost of making bearings could be reduced without dangerously lowering the factor of safety. 3000 w. Am Mach—Vol. 33. No. 49. No. 19212.

**Cast Iron.**

The Physics of Cast Iron. H. M. Lane. Considers the physical changes that take place as the metal cools and the effect these have on the output of the plant. Ills. 6000 w. Am Found Assn—1910. No 19009 N.

Chemical Standards for Iron Castings. Report by John Jermain Porter, Chairman of Committee. A voluminous report on the constitution, properties, and chemica' standards, with a directory of brands of pig iron, and bibliography. 33500 w. Am Found Assn—1910. No. 19008 N.

**Copper.**

Casting Copper of a High Electrical Conductivity. Dr. E. Weintraub. Considers causes of the cavities in copper castings, and the use of boron to solve the problem. 1000 w. Castings—Dec., 1910. No. 19398.

**Economics.**

Material Economics. T. D. Lynch. Discusses the importance of research work, design, manufacture, and cost in the appropriate application of materials. Also discussion. 8500 w. Pro Engrs' Soc of W Penn—Nov., 1910. No. 19546 D.

**Fatigue.**

The Fatigue of Metals and the New Methods of Testing (La Fatigue des Métaux et les Nouvelles Méthodes d'Essais). Ch. Fremont. Discusses particularly in this series the testing of steel for rivets and of welds. Ills. Serial. 1st part. 2500 w. Génie Civil—Nov. 19, 1910. No. 19643 D.

**Heat Treatment.**

The Heat Treatment of Metallic Materials (Quelques Observations sur les Traitements thermiques des Produits métallurgiques). Léon Guillet. The first part discusses tempering. Serial. 1st part. 4500 w. Tech Mod—Nov., 1910. No. 19616 D.

**Metallography.**

Quantitative Analysis of Carbon Steels by Means of the Microscope (Analyse Quantitative Micrographique des Aciers au Carbone). F. Robin. An explanation of the method. Ills. 2500 w. Rev de Mécan—Nov., 1910. No. 19631 E + F.

**Steel.**

Electro Steel—A New Metallurgical Product. Joseph Schaeffers. Information concerning steel manufactured in electric furnaces, its comparative freedom from injurious impurities. Ills. 1200 w. Horseless Age—Dec. 14, 1910. No. 19402.

See also Case Hardening, under MACHINE WORKS AND FOUNDRIES.

**Tin Plate.**

Corrosion of Metallic Food Containers. Edward Gudeman. Read before the Am. Chem. Soc. Reports experiments made to find a metal that would resist the corroding action of food juices. 2000 w. Met & Chem Engng—Dec., 1910. No. 19304 C.

## MEASUREMENT.

**Calorimetry.**

Experiments on a Bomb Calorimeter. E. A. Allcut. Reports experiments undertaken to find out the exact effect on the combustion (if any) of the pressure of oxygen in the calorimeter. Ills. 2000 w. Engng—Dec. 2, 1910. No. 19324 A.

**Hardness.**

The Physical Interpretation of Hardness as Measured by the Shore Scleroscope. Richard Henry Greaves. Describes tests made with this instrument, giving results. 2500 w. Inst of Civ Engrs—No. 3879. No. 19471 N.

**Manograph.**

The Ravigneaux Manograph. W. F. Bradley. Illustrated description of a manograph designed for testing internal combustion motors. 500 w. Mach, N Y —Dec., 1910. No. 19106 C.

**Pressure Gauges.**

The Measurement of the Pressure and Speed of Gases and Steam (Bestimmung des Druckes und der Geschwindigkeit von Gasen und Dämpfen). E. Stach. Describes a number of methods and apparatus for pressure and speed measurement. Ills. Serial. 1st part. 3200 w. Glückauf—Nov. 19, 1910. No. 19682 D.

**Testing Methods.**

See Fatigue, under MATERIALS OF CONSTRUCTION.

## POWER AND TRANSMISSION.

**Air Compressors.**

The "Sentinel" Air-Compressors. Explanation of the aim, and detailed illustrated description of the machine. 1700 w. Col Guard—Nov. 25, 1910. No. 19189 A.

*We supply copies of these articles. See page 839.*

Hydraulic Compressors (Hydraulische Kompressoren). P. Bernstein. Discusses their theory, describes installations, and compares with other methods of air compression. Ills. 7200 w. Zeitschr d Ver Deutscher Ing—Nov. 5, 1910. No. 19837 D.

The Measurement of the Volume of Air Delivered by Reciprocating Compressors (Beitrag zur Frage der Luftmengenmessung bei Kolbenkompressoren). Rudolf Lorenz. Reports the results of a number of tests. Ills. 3000 w. Glückauf—Nov. 26, 1910. No. 19684 D.

**Belt Driving.**

A New Theory of Belt Driving. Selby Haar. A report of modern experimental work and the conclusions reached. 4000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19066 F.

**Compressed Air.**

Compressed Air Transmission Tables Frank Richards. Gives tables showing the loss in head for different initial pressures and rates of flow with various lengths and diameters of pipe. 900 w. Power—Dec. 6, 1910. No. 19134.

**Electric Driving.**

An Electrically Driven Chemical Manure Works. Illustrates and describes the various processes and the conditions under which the electrical machinery is operated in the works at Victoria Docks, London. 1500 w. Engr, Lond—Dec. 2 1910. No. 19330 A.

See also Steel Works, under MINING AND METALLURGY, IRON AND STEEL.

**Lubricants.**

Some Physical and Chemical Properties of Lubricants. F. A. McCarty. Read before the Victorian Inst. of Elec. Engrs Outlines the sources and manufacture of oils, showing where the impurities come from and describes apparatus used and results of tests made with oils and greases 5000 w. Aust Min Stand—Nov. 2, 1910. Serial. 2 parts. No. 19340 each B.

**Mechanical Plants.**

The Whitehall Building's Mechanical Plant. Charles H. Hughes. Illustrates and describes interesting details of the equipment of New York's recently completed 32-story high building. 1700 w. Ir Age—Dec. 29, 1910. No. 19775.

A High School Engineering Equipment, With Unique Features. Plans and description of the new East Side Commercial and Manual Training High School in Newark, N. J. 2500 w. Heat & Vent Mag—Dec., 1910. No. 19556.

**Power Plants.**

The Generation of Power. D. S. Jacobus. Address on the growth in consumption of power, and improvements in its development, with a discussion of the type of boiler best suited for power plant work, and related subjects. 4500 w. Jour Fr Inst—Dec., 1910. No. 19717 D.

Modern Manufacturing Power Plant. Warren O. Rogers. Illustrated description of the mechanical equipment and arrangement of an up-to-date turbine plant. 3000 w. Power—Dec. 13, 1910. No. 19286.

Power Plant Practice. John A. Shaw. Describes the organization and methods found necessary by the Canadian Pacific Ry system to obtain efficient plants. Ills. 6500 w. Can Soc of Civ Engrs—Nov. 10, 1910. No. 19017 N.

**Rope Driving.**

Rope Driving. Thomas Hart. Presents some of the advantages and applications calling attention to important principles to be kept in mind. Ills. 1500 w. Ir & Coal Trds Rev—Dec. 2, 1910. No. 19452 A.

**Turbo-Compressors.**

See Refrigeration, under HEATING AND COOLING.

**Wind Power.**

Water Storage *versus* Storage Batteries. A. W. Barham. Suggests that the water storage scheme proposed by Prof. R. A. Fessenden for utilizing wind power would afford a method of dealing with peak loads on generating stations. 1500 w. Elect'n, Lond—Dec. 2, 1910. No. 19314 A.

## STEAM ENGINEERING.

**Air Pumps.**

Centrifugal Ejector Air Pump and Condenser. Illustrated detailed description of an air-pump which works on a new principle, recently designed by E. S. G. Rees, a development of the Rees returbo centrifugal pump. 1500 w. Engr, Lond—Dec. 2, 1910. No. 19332 A.

Air Pumps and Condensers as Used in Naval Machinery. F. H. Bailey. Lecture before the School of Marine Engng, U. S. Naval Acad. Discusses the importance of keeping air out of the condenser, and the methods of removing steam, air, and fresh water from turbine condensers. 5500 w. Jour Am Soc of Nav Engrs—Nov., 1910. No. 19025 H.

**Boiler Design.**

Steam-Boiler Design. Charles Erith. Compares Dr. Nicolson's experimental boiler with ordinary Lancashire boilers, and discusses the effect of firing; the steaming quality depending on the furnace area and quality of fuel, all boilers giving the same efficiency. 3000 w. Engng—Dec. 2, 1910. No. 19327 A.

**Boiler Efficiency.**

Combustion and Boiler Efficiency. Edw A. Uehling. Discusses the importance of carbon dioxide as an index to combustion and, in connection with flue-gas temperature, to boiler efficiency. Tables. 8500 w Jour Am Soc of Mech Engrs—Dec., 1910. No. 19068 F.

**Boiler Explosions.**

The Distington Multiple Boiler Explosion. The report of Edward G. Hiller, issued by the Nat. Boiler & Gen. Ins. Co.,

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Ltd. Gives interesting details of the disaster. Ills. 2000 w. Mech Engr—Dec. 9, 1910. Serial. 1st part. No. 19434 A.

**Boiler Furnaces.**

Some Important Furnace Alterations. A. D. Blake. Explains how the capacity was increased 33 1/3% by substituting a suspended arch in place of the usual form of sprung arch. Ills. 700 w. Power—Dec. 6, 1910. No. 19133.

**Boiler Insurance.**

Steam Boiler Insurance. Address before the Insurance Institute of Hartford, Conn., by Charles S. Blake. Considers boiler underwriting, inspection and adjustment. 5500 w. Locomotive—Oct. 25 1910. No. 19498.

**Boiler Management.**

The Clinkering of Coal: Results of Tests for Effect of Various Constituents in the Ash. Lionel S. Marks. Reports investigations made to discover how to diminish or modify clinker, explaining its production. Also editorial. 9500 w. Eng News—Dec. 8, 1910. No. 19235.

**Boilers.**

Wooden Boilers. Extract from New Haven *Evening Register*. A republished account of an accident in 1817 to a vessel using wooden boilers, with illustration and description of a wooden boiler. 1000 w. Locomotive—Oct. 25, 1910. No. 19499.

**Boiler Settings.**

Reinforced-Concrete Boiler Settings. W. H. Weston. Gives general working specifications for the construction. 1800 w. Engineering Magazine—Jan., 1911. No. 19745 B.

**Boiler Tests.**

See Steam Boilers, under MARINE AND NAVAL ENGINEERING.

**Boiler Theory.**

Combustion. E. N. Percy. An explanation of energy and heat, the products of combustion, sources of loss and related subjects. 3500 w. Boiler Maker—Dec., 1910. No. 19297.

**Condensers.**

See Air Pumps, under STEAM ENGINEERING.

**Engine Cut-off.**

See Plant Design, under STEAM ENGINEERING.

**Engine Economy.**

Water Rates for Simple Engines. Wallace S. Fowler. Gives curve and method of calculating water consumption for simple engines, both condensing and non-condensing, at different loads. 700 w. Power—Dec. 13, 1910. No. 19287.

**Engine Governing.**

The Governing of Prime Movers. L. Lumb. Abstract of a paper read before the Bradford Engng. Soc. Describes the method of increasing speed variation; the causes of irregularities are discussed. 1600 w. Mech Wld—Dec. 9, 1910. Serial. 1st part. No. 19439 A.

**Engine Governors.**

An Improvement in Isochronal Engine Governors (Un Nuovo Apparato per la Regolazione Isocrona dei Motori). Lamberto Caioli. Describes a device invented by the author for application to centrifugal governors. Ills. 1400 w. Ann d Soc d Ing e d Arch Ital—Oct. 15, 1910. No. 19649 F.

**Engine Repairs.**

Repair of a Large Engine Bed. F. W. Brady and C. J. Mason. The guide barrel was split off from the frame. Illustrated description of method of repairing. 900 w. Power—Dec. 27, 1910. No. 19572.

**Engines.**

Engines with a Minimum of Clearance. Illustrates and describes a Walschaert engine which has a clearance of ½ of one per cent. 500 w. Power—Dec. 13, 1910. No. 19290.

A New Twin-Tandem Rolling Mill Engine. Abstracted from *Stahl und Eisen*. Illustrated description of a twin-tandem reversing rolling-mill engine with built-in pinion housing. 1000 w. Ir & Coal Trds Rev—Nov. 25, 1910. No. 19199 A.

A New Experimental Steam Engine at the Glasgow and West of Scotland Technical College. A. L. Mellanby, Illustrated description of the engine, and results of trials. 3500 w. Inst of Engrs & Shipbldrs in Scotland—April 26, 1910. No. 19772 N.

The Uni-Directional Flow Steam Engine (Die Gleichstrom-Dampfmaschine). J. Stumpf. A detailed description and discussion of the author's system. Ills. Serial. 1st part. 4900 w. Zeitschr d Ver Deutscher Ing—Nov. 5, 1910. No. 19835 D.

**Fuels.**

A Method of Increasing the Calorific Power of Washington Lignites. H. K. Benson. Abstract of a paper submitted for the Karl prize in Ind Chem. A report of experiments and results. 1000 w. Met & Chem Engng—Dec., 1910. No. 19305 C.

North Dakota Lignite as a Fuel for Power-Plant Boilers. D. T. Randall and Henry Kreisinger. A report of tests, describing the fuel, apparatus and methods giving data results of the tests. Ills. 12500 w. U S Bureau of Mines—Bul. 2. No. 19165 N.

See also Briquetting, under MINING AND METALLURGY, COAL AND COKE.

**Fuel Testing.**

Engineer's Problem in Selecting Coal. George H. Bayne. Gives a standardization test of three kinds of coal and sample computations upon which the selection is based. 2500 w. Power—Dec. 6, 1910. No. 19137.

**Heat Accumulators.**

Heat Accumulators for Utilizing Exhaust Steam. E. Stach. From a paper read before the Düsseldorf Cong. Illustrates and describes several types. 700 w.

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Ir & Coal Trds Rev—Nov. 25, 1910. No. 19198 A.

**Heat Transmission.**

A Study in Heat Transmission. J. K. Clement and C. M. Garland. From Bul No. 40, Univ. of Ills. An investigation of the effect of velocity of flow on the rate of transmission of heat through metal walls. 3500 w. Ir Trd Rev—Dec. 1, 1910. No. 19060.

**Plant Design.**

Factors Affecting Plant Costs. H. J. Macintire. Considers factors which determine the location of steam plant and selection of its equipment. Also a graphical method of determining the economical cut-off. 1200 w. Power—Dec. 6, 1910. No. 19135.

**Oil Separators.**

Tests of Oil Separators (Versuche mit Dampfentölern). Reports an elaborate series of tests recently carried out in Germany. Ills. Serial. 1st part. 5400 w. Zeitschr d Ver Deutscher Ing—Nov. 19, 1910. No. 19841 D.

**Steam Pipes.**

Something about Pipe Covering. Trans from *Der Chem.-Tech. Fab.* Shows how the covering can be accomplished with small outlay. 1500 w. Sci Am—Dec. 3, 1910. No. 19099.

**Steam Properties.**

Problem in Expansion of Steam. John French. Presents an approximate solution for determining the pressure at the end of the stroke. 500 w. Power—Dec. 10, 1910 No. 19288.

**Superheating.**

Notes on the Value of Napier's Coefficient with Superheated Steam. Isaac Harter, Jr. Gives observations made in a series of tests. 1000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19067 F.

**Turbine Design.**

The Steam Turbine in Germany. F. E. Junge and E. Heinrich. A comparison of the Rateau and Curtis principles of construction. Ills. 2000 w. Power—Dec. 20, 1910. No. 19458.

**Turbine Governors.**

The Conditions of Absolute Regularity in Governors (Wann wird ein Regulator schwankungslos arbeiten?). Albert Hoeppener. A mathematical and kinematic study of turbine governors. Ills. Serial. 1st part. 3200 w. Die Turbine—Nov. 20, 1910. No. 19698 D.

**Turbine Operation.**

The Running and Upkeep of Parsons Steam Turbines. B. Thomas. Illustrates and examines the parts of a turbine, considering their uses; the method of starting, lubricating, etc. 2500 w. Mech Wld —Dec. 9, 1910. Serial. 1st part. No. 19438 A.

**Turbine Plants.**

The Mixed-Pressure Turbo-Generator Plant at Shaft III of the Constantin der Grosse Mine (Die Zweidruck-Turbogeneratoranlage der Zeche Constantin der Grosse, Schacht III). E. Illgen. Describes a recent plant for the utilization of exhaust steam in the Bochum district, Germany. Ills. 6000 w. Glückauf—Nov. 12, 1910. No. 19681 D.

**Turbines.**

Low Presure Steam Turbines. F. E. McKee. Discusses the subject in a general way as influencing the modernizing of engine plants, and the design of new plants. Also discussion. 3500 w. Pro Engrs Soc of W Penn—Nov., 1910. No. 19545 D.

The Forerunners and Successors of the Curtis Steam Turbine (Die Dampfturbine von Curtis, ihre Vorläufer und Nachfolger). A review of turbine development based on patent literature. Ills. 4000 w. Die Turbine—Nov. 5, 1910. No. 19695 D.

**Turbine Testing.**

Testing Steam Turbines and Steam Turbo-Generators. E. D. Dickinson and L. T. Robinson. Outlines the precautions that must be taken in efficiency tests that the results may not be misleading, and also considers the degrees of accuracy of different methods. 3300 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19709 F.

**Turbine Tests.**

Test of a 9000-KW. Turbo-Generator Set. F. H. Varney. Describes the operation of a plant in California, giving data of tests. 1000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19071 F.

Test of a 10000-KW. Steam Turbine with a Brief Description of Features of Construction. Sam. L. Naphtaly. Refers to the design and operation of a complete expansion turbine installed in a San Francisco station, reporting results of tests. Ills. 3000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19070 F.

Test of a 15000-Kilowatt Steam Engine Turbine Unit. Reports remarkable efficiencies obtained by coupling a low-pressure turbine to a reciprocating-engine installation. Ills. 2500 w. Elec Rev & W Elect'n—Dec. 10, 1910. No. 19268.

Tests of a 200-Kilowatt A. E. G. Turbine (Untersuchung einer 200 KW-A.-E.-G.-Turbine). Report of an elaborate test carried out at the Technical High School Charlottenburg. Ills. Serial. 1st part. 2300 w. Zeitschr f d Gesamte Turbinenwesen—Nov. 10, 1910. No. 19699 D.

## TRANSPORTING AND CONVEYING.

**Aerial Tramways.**

Recent Electrical Transporting and Hoisting Machinery (Neuere Transport- und Hebezeuge mit elektrischem Antrieb). Hubert Hermanns. Describes particularly aerial tramway installations. Ills. Serial. 1st part. 3500 w. Elek Kraft u Bahnen—Nov. 4, 1910. No. 19819 D.

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**Cableways.**

Aerial Ropeway at Steetley Quarries. Illustrations and description of an unusual lay-out, used for distributing the limestone and dealing with the waste. 800 w. Engng—Nov. 25, 1910. No. 19194 A.

A Rock-Transporting Cableway for the Harbor Works of Rangoon, Burmah. Illustrated description of the cableway at Kalagouk island, for supplying rock for a rubble training wall. 1500 w. Eng News—Dec. 8, 1910. No. 19233.

The Wetterhorn Lift at Grindelwald, Switzerland. Dr. E. L. Corthell. Illustrated description of a new method of passenger transportation, and a new method of construction by which considerable elevations may be overcome at comparatively small expense. 2500 w. Eng Rec—Dec. 3, 1910. No. 19085.

Cableways for Passenger Transport (Seilschwebebahnen für Personenbeförderung). M. Buhl. Describes a number of cableway installations for this purpose. Ills. Serial. 1st part. 1800 w. Deutsche Bau—Nov. 5, 1910. No. 19689 B.

**Boiler Settings.**

Mechanical Handling of Coal at the Storage Depots of the Orleans Railway (Note sur l'Organisation de la Manutention mécanique des Combustibles dans les principaux Dépots du Réseau d'Orléans). M. Lacoin. Brief description of the installations. Ills. 1700 w. Rev Gen d Chemins de Fer—Nov., 1910. No. 19615 G.

Coal and Ash Handling Devices at the Reisholz Station of the Rhine-Westfalian Electrical Company (Die Transportanlage der Zentrale Reisholz des Rheinisch-Westfälischen Elektrizitätswerkes A.-G.). A. Pietrkowski. Describes an elaborate installation. Ills. 2300 w. Elek Kraft u Bahnen—Nov. 4, 1910. No. 19820 D.

See also Colliers, under MARINE AND NAVAL ENGINEERING.

**Cranes.**

Rapid Luffing-Cranes at Morocco Wharf, Wapping. Illustrated description of the Mitchell-Williams system. 1700 w Engng—Dec. 2, 1910. No. 19328 A.

**Elevators.**

Operating Conditions of Passenger Elevators. Reginald P. Bolton. Discusses the principles that affect and limit the service. 3000 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19065 F.

Worm Gearing Employed for Freight Elevators. A. P. Eltoft. Suggests improvements and considers the three factors which may determine the minimum size of worm that can be used. 1500 w. Mach, N Y—Dec., 1910. No. 19111 C.

**Freight Handling.**

See Steamships, under MARINE AND NAVAL ENGINEERING.

**Pulley Blocks.**

Chain Pulley Blocks. R. A. Baxter. Considers chain blocks and their upkeep. 1500 w. Mech Wld—Dec. 16, 1910. No. 19591 A.

### MISCELLANY.

**Copying Machines.**

Copying Machines at the Brussels Exhibition. Illustrates and describes types shown by Mr. Curd Nube. 1600 w. Engng—Dec. 16, 1910. No. 19595 A.

**Safes.**

Recent Advances in the Construction of Fire and Burglar-Proof Safes. E. E. Watson. An account of progress during the past century in lock-making and safe-building. 6000 w. Jour Fr Inst—Dec., 1910. No. 19718 D.

**Safety Devices.**

Guarding Gears on Machine Tools. Brief illustrated description of gear covers that prevent all possibility of injury to workmen. 600 w. Am Mach—Vol. 33. No. 50. No. 19345.

Mechanical Appliances for Health and Safety in the Weaving Industry. H. M. Crawford. Illustrates and describes devices for the prevention of injuries to employees. 2500 w. Cassier's Mag—Dec., 1910. No. 19539 B.

**Shoe Machinery.**

Modern Shoe Manufacture. M. B. Kaven and J. B. Hadaway. Description of a modern shoe factory, the methods employed and the machinery used. Ills. 7500 w. Jour Am Soc of Mech Engrs—Dec., 1910. No. 19064 F.

**Typewriters.**

A Typewriter That Operates Without Noise. Illustrated detailed description of a machine, printing by pressure rather than by impact. 1200 w. Sci Am—Dec. 3, 1910. No. 19102.

## MINING AND METALLURGY.

### COAL AND COKE.

**Accidents.**

Mine Accident Prevention. J. J. Rutledge. Read before the Alabama Coal Operators Association. Considers organization and equipment for rescue work and the importance of efficient laws governing coal mining. 4000 w. Mines & Min—Dec., 1910. No. 19126 C.

**Briquetting.**

The Manufacture of Patent Fuel. Gives regulations issued by the Home Office to apply to the manufacture of patent fuel (briquettes) with addition of pitch. 1200 w. Col Guard—Dec. 2, 1910. No. 19322 A.

The Briquetting of Coal Dust. Lindon Bates, Jr. Illustrations and brief description of a Belgian process of great simplic-

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ity. 800 w. Sci Am Sup—Dec. 10, 1910. No. 19248.

**Canada.**

The Production of Coal and Coke in Canada During the Calendar Year 1909. Advance chapter of the annual report on the mineral production of Canada. 8000 w. Can Dept of Mines—1910. No. 19523 N.

**China.**

Native Coal and Iron Working in the Province of Shansi, China. Describes the deposits, tools used, and methods of mining. Plate. 2000 w. Engng—Dec. 2, 1910. No. 19325 A.

**Coal Storage.**

See Coal Handling, under MECHANICAL ENGINEERING, TRANSPORTING AND CONVEYING.

**Coke Industry.**

See Foundry Coke, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

**Coke Ovens.**

Retort Coke Ovens in Mexico. E. B. Wilson. An illustrated account, reporting an increase in percentage of coke, as compared with the output of beehive ovens. 3500 w. Mines & Min—Dec., 1910. No. 19121 C.

**Coking.**

The Removal of Deposits of Graphite from the Riser Flues of By-Product Coke Ovens (Die Entfernung der Graphitansätze aus den Steigerohren der Koksöfen mit Nebenproduktengewinnung). A. Thau. Discusses the causes of graphite deposits and methods and arrangement of the installation for its easy removal. Ills. 3500 w. Glückauf—Nov. 19, 1910. No. 19683 D

**Electric Power.**

The Earthed Concentric System for Direct-Current Colliery Cables. W. Bolton Shaw. Considers the insulation of cables and the advantages of armaturing, describing the system named and discussing single and double concentric cables. 3500 w. Elect'n, Lond—Dec. 9, 1910. No. 19430 A.

Inspection and Repair of Electrical Plant Underground. R. R. Smith. Explains the system employed at the colliery with which the writer is connected. 2500 w. Ir & Coal Trds Rev—Dec. 2, 1910. No. 19455 A.

Mining Switchgear. H. W. Clothier. Before the Nat. Assn. of Colliery Mgrs. A record of experiences, with illustrated description of the leading features in the design of switchgear for mines. Short discussion. 4500 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19707 A.

**Explosions.**

Chemistry of Coal-Dust Explosions Gives results of studies of dust explosions at the experiment station at Liévin, France. 3500 w. Mines & Min—Dec., 1910. No. 19123 C.

The Starkville, Colo., Explosion. Describes the method of mining and ventilating and the conditions before and after the explosion. 3300 w. Mines & Min—Dec., 1910. No. 19122 C.

**India.**

The Pench Valley Coalfield. F. I. Leslie Ditmas. Abstract of paper read before the N. of Eng. Min. & Mech. Engrs. Describes the deposits and the system of working. 2000 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19705 A.

**Mine Dust.**

The Explosibility of Coal Dust. Reviews the history of past investigations of coal dust explosions and the work of the Mining Assn. of Great Britain. 3000 w. Engr, Lond—Dec. 9, 1910. Serial. 1st part. No. 19446 A.

The British Coal-Dust Experiments. Editorial review of the report of the first series of British coal-dust experiments. 3000 w. Engng—Dec. 9, 1910. No. 19444 A

Some French Experiments on Coal Dust. Henry Briggs. Abstract of a bulletin published in April, 1910, giving results of tests made to determine the underground conditions favorable to the production of a coal dust explosion. 7000 w. Eng & Min Jour—Dec. 24, 1910. No. 19534.

**Mine Fires.**

Mine Fires. Thomas K. Adams. Read before the Min. Inst of Am. Draws lessons from fires past, and gives precautions necessary. 2500 w. Mines & Min—Dec., 1910. No. 19125 C.

**Mine Gas.**

Methods of Detecting Fire-Damp in Mines. Sir Henry H. Cunynghame. Gives a brief description of the principal methods of detecting fire-damp. Discussion. 5000 w. Jour Roy Soc of Arts—Nov. 25, 1910. No. 16169 A.

The Safety Lamp and the Estimation of Firedamp. George H. Winstanley. Abstract of paper before the Manchester Geol. & Min Soc. Discusses the use of safety lamps for the detection and estimation of firedamp. Ills. Also describes the "Contra" barometer. 4500 w. Col Guard —Dec. 16, 1910. No. 19592 A.

**Mine Supplies.**

Handling Mine Supplies. H. H. Fitch Read before the Coal Min. Inst. of Am. Explains the advantages of and methods for systematic handling. 9000 w. Mines & Min—Dec., 1910. No. 19124 C.

**Mining.**

Repair Work in Colliery Practice. James A. Seager. Suggestions that may save a colliery from a serious shutdown 2200 w. Eng & Min Jour—Dec. 10, 1910. No. 19264.

**Prices.**

Price Movements in the Coal, Iron, and Zinc Industries (Die Bewegung der Warenpreise im allgemeinen und der Preise

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für Kohle, Eisen und Zink im besondern). Lorenz Glier. A study of conditions in Germany. 7100 w. Glückauf—Nov. 5 1910. No. 19680 D.

**Wales.**

The Geological Structure of the Swansea Valley. Evan Ll. Davies. Read before the Nat. Assn. of Col. Mgrs. Descriptive. 4500 w. Ir & Coal Trds Rev—Dec. 2, 1910. Serial. 1st part. No. 19453 A.

**Washing.**

The Principles and Practice of Coal Washing. Prof. Henry Louis. Discusses its proper application, and the methods employed. 5500 w. Ir & Coal Trds Rev—Dec. 2, 1910. No. 19451 A.

See also Reinforced Concrete, under CIVIL ENGINEERING, CONSTRUCTION.

## COPPER.

**Alaska.**

Chitina Valley Copper Deposits. E. Jacobs. Describes peculiarities of the country and deposits in Alaska made available by a new railroad. Ills. 5000 w. Mines & Min—Dec., 1910. No. 19131 C.

**Arizona.**

The Clifton-Morenci District of Arizona. William L. Tovote. This first article deals principally with the geology of these copper deposits. 3000 w. Min & Sci Pr—Dec. 10, 1910. Serial. 1st part. No. 19372.

**Australia.**

Notes on the Mount Morgan Ore Deposits, Queensland. J. Bowie Wilson. An account of the deposit as it appears today, with the writer's theory concerning its formation. Gives the early history of this gold mine, describes the geology of the district, and gives theories advanced to explain the deposit. Map & Ill. 6000 w. Inst of Min & Met, Bul. No. 74—Nov. 9, 1910. No. 19764 N.

Discussion on "Notes on the Mount Morgan Ore Deposits, Queensland." J. Bowie Wilson's paper is discussed. 4000 w. Inst of Min & Met, Bul. No. 75—Dec. 14, 1910. No. 19769 N.

**Bessemer Process.**

The Successive Stages in the Bessemerizing of Copper Mattes as Indicated by the Converter Flame. Donald M. Levy. Describes in detail the two main stages of bessemerizing copper mattes, illustrating by colored plates. 1700 w. Inst of Min & Met, Bul No. 74—Nov. 9, 1910 No. 19765 N.

**Blast Furnaces.**

An Improvement in Hot-Blast Copper and Lead Smelting. Clement H. Mace. Illustrates and describes a blast furnace invented by Allen R. Partridge, and its operation. 1200 w. Met & Chem Engng —Dec., 1910. No. 19301 C.

**Blast-Furnace Slags.**

Role of Alumina in Copper Blast Furnace Slags. L. Garrett Smith. Vogt's work is cited to prove that it acts as an acid only in slags rich in that mineral and as a base if silica is under 43 per cent. 2000 w. Eng & Min Jour—Dec. 24, 1910. No. 19533.

**Bullion.**

Moisture in Copper Bullion. Donald M. Siddell. A report of experimental tests for moisture, concluding that any bosh-cooled pig is likely to contain moisture. 1000 w. Eng & Min Jour—Dec. 3, 1910. No. 19090.

**Congo.**

The Copper Fields of the Southern Congo. History and information of the district and its development. Map. 3000 w. Min Wld—Dec. 17, 1910. No. 19408.

**Converters.**

Evolution of the American Copper Converter. Charles C. Christensen. Illustrated reveiew of types of copper converters and methods of different experimenters. 1500 w. Min Wld—Dec. 3, 1910. No. 19153.

**Refining.**

An Australian Electrolytic Copper Refinery. R. G. Casey, Jr. Describes the modern smeltery and refinery at Port Kembla. Ills. 3500 w. Eng Min Jour —Dec. 3, 1910. No. 19094.

**Smeltery Gases.**

A Process for Saving Wastes in Smeltery Gases. George C. Westby. Explains a process of treating finely divided slag while in suspension with the smelter gases, resulting in solution of the bases as thionates and sulphates. 5500 w. Eng & Min Jour—Dec. 10, 1910. No. 19262.

**Smelting.**

Pyritic Smelting in Leadville. Charles H. Doolittle and Royal P. Jarvis. Describes the process as carried out in the Bi-Metallic Smelter. 4500 w. Bul Am Inst of Min Engrs—Dec., 1910. No. 19716 F.

## GOLD AND SILVER.

**Alaska.**

See Placers, under GOLD AND SILVER.

**British Guiana.**

Origin of the Placer Gold of Guiana. Lee Fraser. Synopsis of a chapter in "Geology of the Goldfields of British Guiana," by J. B. Harrison. A résumé of the facts, hypotheses and theories. 2500 w. Min & Sci Pr—Nov. 26, 1910. No. 19075.

**Cobalt.**

The Progress of Cobalt. Joseph T. Maudy. The history, geology, ore deposits, etc., are dealt with in this first instalment. 3500 w. Min Jour—Dec. 10, 1910. Serial. 1st part. No. 19433 A.

See also Silver Milling, under ORE DRESSING AND CONCENTRATION.

**Colombia.**

Alluvial Gold Deposits and Mining in Colombia. P. A. Alig. Information concerning the production, the extent of the

deposits, operating facilities and general conditions. 1500 w. Eng & Min Jour—Dec. 3, 1910. No. 19091.

**Colorado.**

See Gold Milling, under ORE DRESSING AND CONCENTRATION.

**Cyaniding.**

The Classification of Tailing Pulp Prior to Cyaniding. Edward H. Johnson. Reviews attempts made to produce a classified product, and gives experience gained with the continuous sand collecting system. Ills. 2000 w. Jour Chem, Met & Min Soc of S Africa—Oct., 1910. No. 19412 E.

Cyaniding in the Philippines. C. M. Eye. An illustrated review of methods. 3000 w. Far East Rev—Oct., 1910. No. 19204 N.

See also Gold Milling, under ORE DRESSING AND CONCENTRATION.

**Dredging.**

Kolchan Placer of the Orsk Goldfields, Ltd. Information, from reports by Purington and Hutchins, concerning this eastern Siberian dredging field. 2500 w. Eng & Min Jour—Dec. 7, 1910. No. 19392.

**Mexico.**

The Antigua Mines of Real de Sivirijoa, Sinaloa. E. A. H. Tayo. An account of a mine discovered in 1715 and worked for nearly a century. 2000 w. Eng & Min Jour—Dec. 10, 1910. No. 19259.

Minas Pedrazzini Operations Near Arizpe, Sonora. Edward L. Dufourcq. Describes deposits of high-grade silver ore in rhyolite, and evident secondary enrichment. 2200 w. Eng & Min Jour—Dec. 3, 1910. No. 19092.

**Nicaragua.**

The Gold Mining Industry in Nicaragua. T. Lane Carter. Gives information concerning conditions, mining laws, geology, labor, etc. Ills. 3000 w. Eng & Min Jour—Dec. 17, 1910. No. 19393.

**Placers.**

Nome Placer Mining. T. M. Gibson. Information concerning the work of the past season, and of a new find that may prove important. 1800 w. Min & Sci Pr—Dec. 17, 1910. No. 19504.

See also Dredging, under GOLD AND SILVER.

**Refining.**

Bullion Refining at Waihi G. M. Co. New Zealand. J. G. Goosman. Illustrated description of an electrolytic parting plant and oil furnace. 1800 w. Aust Min Stand—Oct. 26, 1910. No. 19338 B.

**Russia.**

See Dredging, under GOLD AND SILVER.

**Spain.**

The Silver-Bearing Veins of Hiendelaencina, Guadalajara, Spain. Vicente Kindelan. Describes the geology and vein system of the region, and reports operations in 1908. 1500 w. Min Jour—Dec. 17, 1910. No. 19586 A.

## IRON AND STEEL.

**Alabama.**

The Hematitis of Alabama. J. Sharshall Grasty. Illustrated description of the iron ore deposits, with special reference to those of the Cambrian Age. 4000 w. Mfrs' Rec—Dec. 1, 1910. No. 19039.

**Blast Furnace Air.**

Determining Moisture in Air Blast. Clarence P. Linville. Describes a simple method of ascertaining the humidity of the air entering the stack. Ills. 1500 w. Ir Trd Rev—Dec. 29, 1910. No. 19777.

**Blast Furnace Charging.**

Progress in Blast-Furnace Charging Apparatus (Fortschritte auf dem Gebiete der Hochofenbegichtung). Describes some recent installations in Germany. Ills. Serial. 1st part. 2600 w. Stahl u Eisen—Nov. 2, 1910. No. 19664 D.

**Blast Furnace Operation.**

Some Calculations Pertaining to the Reactions Occurring in a Blast Furnace. W. D. Brown. Gives explanation of calculations, and also presents the results as formulae. 4000 w. Met & Chem Engng—Dec., 1910. No. 19299 C.

Investigations of the Material and Heat Balance of the Blast Furnace (Untersuchungen über die Stoff- und Wärmebilanz des Hochofens). W. G. Gillhausen. Works out the heat balance for four runs. Ills. 2800 w. Stahl u Eisen—Nov. 16, 1910. No. 19671 D.

**Blast Furnaces.**

New Plant at the Kettering Blast Furnaces. Plate and detailed description. 1500 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19706 A.

**Canada.**

The Production of Iron and Steel in Canada During the Calendar Year 1909. Advance chapter of the annual report on the mineral production of Canada. 7000 w. Can Dept of Mines—1910. No. 19524 N.

**China.**

See same title, under COAL AND COKE.

**Electrometallurgy.**

First Norwegian Electric Steel Works Dr. Alfred Gradenwitz. Illustrates and describes an interesting application of the Hiorth system. 900 w. Sci Am Sup—Dec. 10, 1910. No. 19247.

The Electric Furnace in the Iron and Steel Industry (Der elektrische Ofen in der Eisen- und Stahlindustrie). Viktor Engelhardt. Describes the various furnaces, the extent of the industry, the cost of the electric process in comparison with other processes, etc. Ills. 7800 w. Zeitschr d Ver Deutscher Ing—Nov. 19, 1910. No 19840 D.

**Ferro-Alloys.**

The Ferro-Alloys Employed in the Manufacture of Iron and Its Products (Les Ferro-Alliages Employés dans la Fabrication du Fer et de ses Dérivés).

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Cl. Berger. Describes briefly their manufacture, properties, and uses. 1500 w. Serial. 1st part. Rev Indus—Nov. 26, 1910. No. 19637 D.

Slowly Cooled Spiegeleisen (Ueber langsam erstarrtes Spiegeleisen). Bernhard Osann. Reports tests in spiegeleisen manufacture, the results of which offer valuable lessons for foundry practice. Ills. 2000 w. Stahl u Eisen—Nov. 9, 1910. No. 19668 D.

**Germany.**

The Iron-Ore Resources of Germany (Die Eisenerzvorräte des Deutschen Reiches). G. Einecke and W. Köhler. Describes three Bavarian deposits of iron ore. 2000 w. Stahl u Eisen—Nov. 2, 1910. No. 19665 D.

**Great Britain.**

The Iron-Ore Resources of the United Kingdom. Henry Louis. Abstracted from "The Iron Resources of the World." Vol. II. Considers the ores of the United Kingdom. 7000 w. Ir & Coal Trds Rev—Dec. 9, 1910. No. 19456 A.

**Hot-Blast Stoves.**

The Design and Heating Power of Hot-Blast Stoves (Berechnung und Wärmeausstrahlung steinerner Winderhitzer). A reply by Osann to Aldendorff's criticisms in *Stahl und Eisen* for July 27, 1910. with a rejoinder by Aldendorff. 5500 w. Stahl u Eisen—Nov. 23, 1910. No. 19674 D.

**Mexico.**

Iron-Ore Resources of Mexico. Ezequiel Ordonez. From a report submitted to the Nat. Geol. Cong. Information concerning extensive deposits, many at present inaccessible. 1200 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19708 A.

**Minnesota.**

Iron Mining in Minnesota. E. K. Soper. Illustrated account of mining methods and production. 2200 w. Min & Sci Pr—Dec. 10, 1910. No. 19371.

**Ore Dressing.**

See Iron Ore, under ORE DRESSING AND CONCENTRATION.

**Ore Resources.**

The Iron-Ore Resources of the World (Die Eisenerzvorräte der Welt). W. Köhler. A review of the report to the International Geological Congress. Serial. 1st part. 4900 w. Stahl u Eisen—Nov. 16, 1910. No. 19669 D.

**Plate Shears.**

Hydraulic Plate Shears. Illustrated description of an interesting plant for shearing steel plates. 1000 w. Engr, Lond—Nov. 25, 1910. No. 19197 A.

**Prices.**

See same title, under COAL AND COKE.

**Rolling Mills.**

Development of the Universal Mill. B H. Reddy. Discusses the difficulties which beset the earlier designs and the improvements effected. Ills. 2000 w. Ir Trd Rev—Dec. 15, 1910. No. 19341.

The Spread of Iron in Finishing Rolls (Die Breitung des Eisens in Glattwalzen). Adolf Falk. A criticism of Scheld's theory of lateral extension. Ills. 4800 w. Stahl u Eisen—Nov. 23, 1910. No. 19672 D.

The Production of I Sections and Broad-Flanged Beams (Ueber die Herstellung von I-Eisen und breitflanschigen Trägern mit neigungslosen Flanschen). A discussion of rolls and rolling practice for producing these sections. Ills. 4800 w. Stahl u Eisen—Nov. 16, 1910. No. 19670 D.

See also Steel Works, under IRON AND STEEL; and Engines, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

**Spain.**

Malaga Magnetites. F. Gillman. Further information concerning the ore deposits of the Malaga serpentines (Spain). Ills. 500 w. Inst of Min & Met, Bul No 75—Dec. 14, 1910. No. 19766 N.

**Steel Making.**

Recent Progress in the Metallurgy of Iron (Progrès Récents de la Sidérurgie). Henry Le Chatelier. A brief review of recent technical progress in the fabrication and use of iron and steel. 4800 w Rev Gen d Sci—Nov. 15, 1910. No. 19612 D.

**Steel Works.**

Electric Power in Steel Works and Rolling Mills. A series of tables giving the essential details of the equipment of generating plants and of electrically driven pumps, blowers, rolls, and cranes in Belgian steel works and rolling mills. Soc Belge d'Elecns—Oct., 1910. No. 19606 E

**Tin Plate.**

The Manufacture of Tin Plate (Die Fabrikation der Weissbleche). W. Krämer. A brief review of modern practice and apparatus. Ills. Serial. 1st part. 2300 w. Stahl u Eisen—Nov. 23, 1910 No. 19673 D.

## LEAD AND ZINC.

**Arizona.**

Zinc Mines of the Hualapai District, Arizona. Newman B. Gregory. Describes the deposits and the development of this region. 1500 w. Min Wld—Dec. 24, 1910 No. 19560.

**Colorado.**

The Zinc--Carbonate Discoveries in Leadville. Gives information concerning this district and its mineral deposits, especially the discoveries recently made in ground thought to have been worked out. 2000 w. Min Wld—Dec. 17, 1910. No. 19409.

**Lead Assaying.**

The Determination of Lead in Non-Ferrous Alloys. C. P. Karr. Considers methods of assay applying to alloys into which lead enters in the course of foundry practice. 3000 w. Am Brass Found Assn—1910. No. 19011 N.

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**Lead Pigments.**

The Mild Process of White Lead Manufacture. R. R. White. Explains the merits of this new process. 1500 w. Wis Engr—Dec., 1910. No. 19520 C.

**Lead Smelters.**

New Lead Smelters for Webb City, Missouri. Otto Ruhl. Illustration, with description of the fourth lead smelter for the Joplin district. 1200 w. Min Wld—Dec. 3, 1910. No. 19156.

**Lead Smelting.**

The Smelting of Lead-Antimony Ores. A. W. Hahn. Describes a small smeltery in Mexico smelting lead-antimony ores and making a saving at one operation of both the lead and antimony. 1000 w. Met & Chem Engng—Dec., 1910. No. 19306 C.

See also Blast Furnaces, under COPPER.

**Prices.**

See same title, under COAL AND COKE.

## MINOR MINERALS.

**Antimony.**

See Lead Smelting, under LEAD AND ZINC.

**Borates.**

The Origin and Commercial Value of Borates. Gordon Surr. Information concerning borax and other borates. 2500 w. Min Wld—Dec. 17, 1910. No. 19407.

**Cement.**

A New Crescent Portland Cement Mill. Illustrated description of a new Plant in Pennsylvania. 2000 w. Eng Rec—Dec. 3, 1910. No. 19089.

The Manufacture of Portland Cement (La Fabbricazione del Cemento Portland). Considers the relative merits of dry and wet processes. Serial. 1st part. 2600 w. Il Cemento—Nov. 15, 1910. No. 19658 D.

**Chromium.**

The Distribution and Utilization of Chromium Ores. A *résumé* of information regarding this metal. 3000 w. Bul of Imp Inst—Vol. VIII. No. 3. Serial. 1st part. No. 19495 N.

**Lime.**

Methods of Manufacturing Hydrated Lime. Ernest McCullough. Information about this material and its making. 1500 w. Min Wld—Dec. 3, 1910. No. 19157.

**Manganese.**

Ferro-Manganese Value of Indian Manganese Ore. Abstracted from "The Manganese Ore Deposits of India," by L. Leigh Fermor. 2500 w. Ir & Coal Trds Rev—Nov. 25, 1910. No. 19200 A.

**Mercury.**

The Cinnabar Deposits of Terlingua, Texas. W. D. Hornaday. Illustrated account of this quicksilver district, and the one operating mine. 1400 w. Min Wld—Dec. 17, 1910. No. 19406.

**Oil.**

The Origin and Distribution of Petroleum. F. I. Wilbur. Reviews the theories generally accepted and gives opinions of mineralogists of note. 3000 w. Min Wld—Dec. 3, 1910. No. 19154.

Oil Losses by Fire. Charles A. Sidman. Illustration, with discussion of some causes of oil fires, and some methods of extinguishing them. 1000 w. Sci Am—Dec. 10, 1910. No. 19244.

Oilfields of Sakhalin. Constantine E. Pfaffius. Map and information concerning the extensive oil-belts. 1000 w. Mining Mag—Dec., 1910. No. 19738 B.

The Saghalien Oilfields. E. de Hautpick. Information concerning the mineral wealth of the island, especially the petroleum. 1000 w. Min Jour—Dec. 3, 1910. No. 19318 A.

The Taman Peninsula Oilfields (Northern Caucasus). E. de Hautpick. Describes the geology and gives details of the outcrops of petroleum-bearing strata. 1500 w. Min Jour—Dec. 17, 1910. No. 19585 A.

**Phosphates.**

A New Plant for the Production of Superphosphate of Lime. Plans and description of a plant for the economical production of artificial manures. 2000 w. Engr, Lond—Dec. 16, 1910. No. 19702.

**Potash.**

Germany's Great Potash Deposits and Mines. Robert J. Thompson. Illustrated article giving information of the deposits and their mining. 2000 w. Min Wld—Dec. 24, 1910. No. 19562.

**Rubies.**

The Ruby. Morris R. Ward. Information concerning the composition, color characteristics, methods of mining, and manufacture of artificial rubies. 2500 w. Mines and Min—Dec., 1910. No. 19132 C.

**Sapphires.**

The Sapphire Fields of Central Queensland. J. Stewart Nesbitt. Describes the country and gem fields, and the method of treating the material. 2200 w. Aust Min Stand—Oct. 26, 1910. No. 19339 B.

**Tantalum.**

On an Indirect Method for Determining Columbium and Tantalum. H. W. Foote and R. W. Langley. Explains method and gives results. 2500 w. Am Jour of Sci—Dec., 1910. No. 19728 D.

Note on a Recent Method for Separating Tantalum and Columbium. H. W. Foote and R. W. Langley. Considers the method proposed by Weiss and Landecker. 600 w. Am Jour of Sci—Dec., 1910. No. 19729 D.

**Tin.**

Notes on the Occurrence and Concentration of Tin Ores. C. Fred. Thomas. Describes the occurrence and production of tin, and modern practice at a plant in Cornwall for treating complex ore. 4000 w. Jour Chem, Met & Min Soc of S Africa—Oct., 1910. No. 19413 E.

Tin Sluicing in Tasmania. Edward Edwards. Explains the methods of pros-

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pecting and breaking down the ground, and the arrangement of sluices. Ills. 8000 w. Mines & Min—Dec., 1910. No. 19130 C.

**Vanadium.**

Notes on the Chemistry and Metallurgy of Vanadium. Warren F. Bleecker. Aims to give information intended to be accurate, and opinions of value. Deals with the chemistry of vanadium, vanadium analysis, and some new metallurgical methods. 6000 w. Met and Chem Engng —Dec., 1910. Serial. 1st part. No. 19300 C.

## MINING.

**Accidents.**

Compensation for Industrial Accidents. David Ross. Discusses the resolution adopted by the Am. Min. Cong. at its Los Angeles meeting. 2500 w. Min & Sci Pr—Dec. 3, 1910. No. 19255.

Mine Accident Investigations. George S. Rice. Read before the Am. Min. Cong. Discusses the method of tabulation of accidents in metal and other mines suggested by the Bureau of Mines. 4000 w. Mines & Min—Dec., 1910. No. 19127 C.

**Boring.**

Oil-Well Drilling in California. William R. Jewell. A discussion of methods and costs. 1500 w. Min & Sci Pr—Dec. 10, 1910. No. 19373.

**Drilling.**

See Tunnelling, under MINING.

**Education.**

Old-Time Mining Schools and Mining. W. C. Wynkoop. A review of educational facilities in mining and metallurgy about fifty years ago. 1800 w. Min & Sci Pr—Dec. 3, 1910. No. 19253.

**Electric Hoisting.**

Electric Winding. J. C. Wilson. Address opening a discussion. Considers the distinguishing features, types of winders, arrangement, gearing, etc. Also discussion. Ills. 9500 w. Ir & Coal Trds Rev —Dec. 2, 1910. No. 19454 A.

Electrically-Driven Winding and Haulage Gears. Illustrated description of the plant constructed for operation in the shale mines at Linlithgow, N. B. 500 w. Engr, Lond—Dec. 9, 1910. No. 19449 A.

Electric Winders for Collieries. Reports an interesting discussion at Newcastle, introduced by J. G. Wilson. 6000 w. Col Guard—Dec. 2, 1910. Serial. 1st part. No. 19323 A.

Control of Electric Winding and Hoisting Engines. Dr. E. Rosenberg. Read before the Manchester Sec. of the Inst. of Elec. Engrs. Discusses the Ward-Leonard system and the rheostatic control of direct-current motors, and of induction motors, in the present number. Ills. 4000 w. Mech Engr—Dec. 16, 1910. Serial. 1st part. No. 19589 A.

Electric Winding, with Special Reference to its Development in Upper Silesia. Henry Moore Hudspeth. The economies resulting from its use are considered, and plants described. Also discussion. 8000 w. Ir & Coal Trds Rev—Dec. 16, 1910. No. 19704 A.

**Electric Power.**

Earthing of Electrical Apparatus. G. A. Webb. Discusses means for efficiently earthing underground electrical plant in mines, so as to minimize risk of accidents. Also suggestions as to earth indicators. 1400 w. Elect'n, Lond—Dec. 2, 1910. No. 19315 A.

**Haulage.**

See Electric Hoisting, under MINING.

**Labor.**

Handicaps of Rigid Working Hours. Discusses the effect of the Eight-Hour Act in Great Britain and why it is unpopular. 3000 w. Eng & Min Jour—Dec. 3, 1910. No. 19095.

**Machinery.**

The Substitution of Machines for Hand Labor in Mining (Der Ersatz des Handarbeiters durch die Maschine im Bergbau). Herr Kammerer. A review of the development of mining machinery of all classes. Ills. Serial. 1st part. 3500 w. Zeitschr d Ver Deutscher Ing—Nov. 5, 1910. No. 19834 D.

**Methods.**

A Revolution in Mining Methods. G. E. Wolcott. Explains a channeling method and its advantages. 3000 w. Min & Sci Pr—Nov. 26, 1910. No. 19076.

Mining and the Industrial Evolution R. B. Lamb. Considers the methods of the past, present and future. 4000 w. Can Min Jour—Dec. 15, 1910. No. 19459

**Prospecting.**

Prospecting in the North. Horace V. Winchell. Describes the region surrounding the Portland Canal as illustrating conditions north of the 40th parallel, compares them with conditions further south, and discusses the differences to be observed in ore deposits. 2000 w. Mining Mag—Dec., 1910. No. 19736 B.

**Shaft Sinking.**

Extension of a Colliery Working Shaft. M. S. Hachita. Gives details of cost and method used in sinking an old shaft, which was in constant use, to a lower level without stopping mining operations. Ills. 1200 w. Eng & Min Jour—Dec. 10, 1910. No. 19263.

**Stowing.**

Sand-Filling on the Witwatersrand. Contributions to the discussion of Edgar Pam's paper on this subject, giving details of the work. Ills. 3000 w. Jour Chem, Met, & Min Soc. of S Africa—Oct., 1910. No. 19414 E.

**Surveying.**

Mine Surveying Methods Employed at Butte, Mont. Paul A. Gow. An explanation of practice followed in this district. 2500 w. Eng & Min Jour—Dec. 17, 1910. No. 19394.

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**Tunnelling.**

Fast Driving at the Goldfield Consolidated Mines. Claude T. Rice. Explains conditions under which the work was done, and the time and rate of drilling. 1200 w. Eng & Min Jour—Dec. 24, 1910. No. 19530.

## ORE DRESSING AND CONCENTRATION.

**Briquetting.**

Iron Ore and Flue Dust Briquetting. Describes briefly the Schumacher and Ronay processes. Ills. 1200 w. Ir Age—Dec. 8, 1910. No. 19225.

**Buddles.**

The Buddle as a Concentrator of Copper Slimes. Claude T. Rice. A report of its use at the Ohio Copper mill, in Utah. Not understood by early millmen. Not adapted to the treatment of sands. Ills. 1500 w. Eng & Min Jour—Dec. 3, 1910. No. 19093.

**Calcining Furnaces.**

The Möller and Pfeifer Calcining Furnace (Kanalbrennofen von Möller und Pfeifer). W. Wollenweber. Describes a gas-fired furnace used in the Rhine-Westfalian coal district, Germany, for calcining argillite occurring in the coal seams for brick making. Ills. 2000 w. Glückauf —Nov. 5, 1910. No. 19679 D.

**Chilian Mills.**

Notes on Chilian Mills in Russia. H. C. Bayldon. Notes on the slow running "edge runner" mill used in Russia for crushing gold ores as a preliminary to amalgamation. Ills. 4500 w. Inst of Min & Met, Bul No. 75—Dec. 14, 1910. No. 19767 N.

**Copper.**

Designing a Thousand-Ton Concentrating Plant. Charles C. Christensen. Describes the method of planning a modern concentrating mill, representing the most recent practice in fine ore concentration, for treating a chalcopyrite ore. 1800 w. Min & Sci Pr—Dec. 17, 1910. No. 19503.

**Electrostatic Separation.**

Electrostatic Separation and Ore Dressing. F. S. McGregor. Abstract from paper read before the Elec-Chem Soc. Illustrated descriptions of plants and the scheme of separation. 2000 w. Min Wld —Dec. 3, 1910. No. 19155.

**Gold Milling.**

Reducing Mining Costs and Increasing Profits. Philip Argall. Address at banquet in celebration of the first month's run of the second unit of Stratton's Independence mill. Deals with the reduction made in cost of treatment of sulpho-telluride ores of the Cripple Creek District. 2000 w. Eng & Min Jour—Dec. 24, 1910. No. 19531.

Wasp No. 2 Cyanide Mill, Black Hills, S. D. Jesse Simmons. Illustrated description of the new cyanide mill which expects to achieve mining and milling at a cost of under a dollar a ton. 1200 w. Min Wld—Dec. 24, 1910. No. 19559.

See also Cyaniding, under GOLD AND SILVER.

**Grinding.**

The Jackson Grinding-Mill. Illustrated description of a mill for pulverizing materials. 900 w Engng—Dec. 6, 1910. No. 19596 A.

**Iron Ore.**

Georgia Brown Iron-Ore Washeries. E. F. McCrossin. Illustrates and describes the methods of handling and cleaning the ore. 1700 w. Mines & Min—Dec., 1910. No. 19128 C.

**Sampling.**

Contribution to the Philosophy of Shipment Sampling. Joseph T. Mandy. A comparative analysis of hand and mechanical sampling. 4500 w. Can Min Jour—Dec. 1, 1910. No. 19168.

**Silver Milling.**

Hydrometallurgy of Cobalt Ores. Illustrates and describes the different methods of treatment as shown by flow sheets of the principal mills. 4500 w. Mines & Min—Dec., 1910. No. 19129 C.

Hydrometallurgical Operations at Cobalt. John Tyssowski. Thirteen operating mills treat over 1,000 tons per 24 hours. Ills. 3300 w. Eng & Min Jour—Dec. 24, 1910. No. 19532.

**Slimes Treatment.**

See Buddles, under ORE DRESSING AND CONCENTRATION.

## MISCELLANY.

**Australia.**

The Progress and Prospects of Mining in Western Australia. A. Montgomery. Descriptive account of the country, the known mineral deposits, geological history, the value of the mines, opportunities for capital, etc. Discussion. 19000 w. Jour Soc of Arts—Dec. 9, 1910. No. 19410 A.

**Chlorine.**

The Origin of the Chlorine of the Ocean. Gordon Surr. Attributes the chlorine of the sea largely to volcanic agencies. 1500 w. Min Wld—Dec. 10, 1910. No. 19283.

**Düsseldorf Congress.**

The International Congress of Metallurgy at Düsseldorf (Le Congrès International de la Métallurgie à Düsseldorf). M. Arnou. An account of the proceedings of the metallurgical section, followed by abstracts of the papers read. Ills. 47500 w. Rev de Métal—Nov., 1910. No. 19611 E + F.

**Geological Surveys.**

Value of Geological Work in Limestone Regions. Claude T. Rice. Remarks on methods employed by different companies, and on the importance of obtaining reliable information of the underground geology. 3500 w. Eng & Min Jour—Dec. 10, 1910. No. 19261.

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# RAILWAY ENGINEERING.

## CONDUCTING TRANSPORTATION.

**Signaling.**

Recent Developments in Signaling. A. H. Rudd. From a paper read before the Can. Ry Club. Discusses some of the problems concerning indications to be given. 3500 w. Ry Age Gaz—Dec. 23, 1910. No. 19510.

The Over-Running of Signals Standing at Danger. Mr. Hoogen. Trans. from *Zeit. des Ver. Deut. Eisenbahnverwaltungen.* Considers devices used to supplement visible signals. 4000 w. Bul Int Ry Cong—Nov., 1910. No. 19750 G.

An Improved Method of Producing Sound Waves for Signalling. Illustrates and describes apparatus for producing continuous or interrupted trains of sound waves which, when propagated by air or water, may be heard or detected in any known manner. 1500 w. Prac Engr—Dec. 2, 1910. No. 19316 A.

Detectors. A. H. Johnson. Read before the Inst. of Sig. Engrs. Considers the detection systems of railway signalling, and especially the advantages of electrical detection. Ills. 2000 w. Elec Engr, Lond—Dec. 9, 1910. No. 19419 A.

**Train Speed.**

High Speeds and Their Relation to Modern Practice in Railway Alignment. Charles F. Draper. Discusses the limitations of speeds on railway curves. Ills. 3500 w. Cassier's Mag—Dec., 1910. No. 19540 B.

## MOTIVE POWER AND EQUIPMENT.

**Air Brakes.**

The Air-Brake as Related to Progress in Locomotion. Walter V. Turner. Reviews successive developments in train control apparatus, discussing principles, methods, and conditions of service. Ills. 8500 w. Jour Fr Inst—Dec., 1910. Serial. 1st part. No. 19720 D.

Blow at Distributing Valve Exhaust Port. A discussion of leakage in air-brakes. Ills. 1800 w. Ry & Loc Engng—Dec., 1910. No. 19149 C.

**Car Journals.**

The Proportions of Rolling-Stock Journals. T. Robson. Develops a formula by which the dimensions and surface speeds of journals can be fixed for different loads. 2500 w. Engng—Nov. 25, 1910. No. 19190 A.

**Electrification.**

Electric Railway Cost Estimating. H. M. Hobart. Read before the Arc Works Engng. Soc., England. Discusses the electrification of suburban service on steam roads, describing the estimation of costs for a hypothetical case. 5000 w. Elec Engr, Lond—Nov. 25, 1910. No. 19177 A.

Electrification of the New York Central Railroad. Edwin B. Katte. Abstract of a lecture at Sibley College. An illustrated description of the apparatus in the Port Morris Power Station, and other features of the work. 2500 w. Sib Jour of Engng—Nov., 1910. No. 19019 C.

The Electrification of the Detroit Tunnel. James Cooke Mills. Illustrated description of the installation of electric traction machinery. 3000 w. Cassier's Mag—Dec., 1910. No. 19541 B.

The Substitution of Electric Traction for Steam in the Boston Metropolitan District. Gives abstracts of reports made by the N. Y., N. H., & H. R. R. and the B. & A. R. R. 4500 w. Eng News—Dec. 8, 1910. No. 19243.

The Electrification of the Harton Coal Company's Railways and Shunting Yards. A. Schmit. Explains the reasons that led to the adoption of electricity, the advantages, etc., and gives an illustrated description of the installation. 4000 w. Ir & Coal Trds Rev—Dec. 2, 1910. No. 19450 A.

**Freight Cars.**

The Clark Quick-Dumping Steel Ore Car. James S. Martin. Illustrated detailed description with report of tests. 900 w. Eng News—Dec. 1, 1910. No. 19057.

**Locomotive Balancing.**

Counterbalancing the Driving Wheels of a 2-6-0 Locomotive. M. H. Westbrook. Gives data obtained while correcting the counterbalancing of an engine upon which several changes had been made. Ills. 1500 w. Mach (Ry Ed)—Dec., 1910. No. 19293 C.

**Locomotive Boilers.**

Experiments on the Influence of the Wade-Nicholson Arch on the Output of Locomotive Boilers. M. V. Gololobow. Deals with experiments carried out at the locomotive testing plant at the Poutilow works. 3500 w. Bul Int Ry Cong—Nov., 1910. No. 19749 G.

**Locomotive Design.**

Weight Equalization on Locomotive Wheels. G. M. Eaton. Explains the fundamental principles of the equalizing system and the performance of locomotives. 2000 w. Elec Jour—Dec., 1910. No. 19513.

**Locomotive Evaporation.**

Quality of Steam and Factor of Evaporation in Locomotive Tests. J. E. Gardner and L. W. Wilson. Gives curves worked out to determine the factors of evaporation based on 98.5 per cent. dry steam, with explanatory notes. 600 w. Ry Age Gaz—Dec. 16, 1910. No. 19374.

**Locomotive Firebox.**

Improved Firebox with Hollow Arch and Combustion Chamber. F. F. Gaines.

*We supply copies of these articles. See page 839.*

Illustrates and describes a design with a long fire-box, a combustion chamber and spark hopper, reporting test. 1500 w. Boiler Maker—Dec., 1910. No. 19298.

Water Tube Fire Boxes for Locomotives. Illustrated description of the Brotan water-tube boiler which has been successfully used in foreign countries, with notes on other water-tube arrangements. 2000 w. Am Engr & R R Jour—Dec., 1910. No. 19217 C.

**Locomotive Flues.**

Flue Failures. J. W. Kelly. Illustrated discussion of some of the causes, also the repairs and remedies. General discussion. 13000 w. Pro W Ry Club—Nov. 15, 1910. No. 19753 C.

**Locomotive Journals.**

See Car Journals, under MOTIVE POWER AND EQUIPMENT.

**Locomotive Operation.**

Locomotive Fuel Economy. A. G. Kinyon. A discussion of possible improvements in economy in the supply of coal, condition of locomotives, use of the fuel, management of fires, etc. Also discussion. 15000 w. Pro Ry Club of Pittsburgh—Oct. 28, 1910. No. 19751 C.

**Locomotives.**

Mallet Locomotives for the Chesapeake & Ohio Railway. Illustrated description of a 2-6-6-2 engine designed to meet special conditions. 700 w. Am Engr & R R Jour—Dec., 1910. No. 19216 C.

Balanced Compound Atlantic Type Locomotives; Atchison, Topeka & Santa Fe. Describes recent changes in design of these locomotives, giving dimensions and illustrations. 500 w. Ry Age Gaz—Dec. 23, 1910. No. 19512.

Ten-Wheeled Locomotive for the Central Railroad of New Jersey. Illustrated description of one of ten engines for fast-freight service. They are hard coal burners with modified Wootten boilers. 700 w. Ry & Engng Rev—Dec. 10, 1910. No. 19285.

Recent Mallet Articulated Locomotives. Illustrates and describes designs for the St. Louis & San Francisco, and for the Chesapeake & Ohio. 1200 w. Ry Age Gaz—Dec. 16, 1910. No. 19375.

Heavy Power for the Hocking Valley Ry. Illustrates and describes new engines to replace the light-power formerly used. 500 w. Am Engr & R R Jour—Dec., 1910. No. 19218 C.

Consolidation Type for the Western Maryland Railway. Illustrated description of heavy locomotives for a line having heavy grades. 1000 w. Ry & Loc Engng—Dec., 1910. No. 19151 C.

The Great Western Railway. An illustrated review of the locomotive history of the Great Western broad gauge, and of subsequent developments on this railway. 3 plates. 25000 w. Engr, Lond—Dec. 16, 1910. No. 19599 A.

New Express Engines, North Staffordshire Railway. Illustrations and brief description of bogie engines for heavy service. 2500 w. Engr, Lond—Dec. 2, 1910. No. 19331 A.

The Paris-Lyons-Mediterranean Locomotive at the Brussels Exhibition. Plate, and illustrated description. 1000 w. Engng—Dec. 9, 1910. No. 19443 A.

New Baltic Type, Compound, Superheated Steam Locomotives. Charles R. King. Illustrated description of powerful locomotives for the Northern Railways of France. 2500 w. Mach (Ry Ed)—Dec., 1910. No. 19296 C.

Locomotives at the Brussels Exposition (Die Lokomotiven auf der Weltausstellung in Brüssel 1910). Herr Metzeltin. Begins a detailed description of the exhibits. Ills. Serial. 1st part. 8400 w. Zeitschr d Ver Deutscher Ing—Nov. 12, 1910. No. 19838 D.

Recent Types of Locomotives on the Belgian State Railways (Note sur les Types récents de Locomotives des Chemins de Fer de l'Etat Belge). Fernand Dubar. Describes three recent types, Nos. 9, 10, and 36. Ills. 2500 w. Tech Mod—Nov., 1910. No. 19617 D.

Class D Freight Locomotive with 200 Square Metres of Heating Surface on the Prussian-Hessian State Railways (Die D-Güterzuglokomotive mit 200 qm Heizfläche der preussich-hessischen Staatseisenbahnen). G. Hammer. Detailed description. Ills. 5000 w. Zeitschr d Ver Deutscher Ing—Nov. 26, 1910. No. 19843 D.

**Locomotive Spark Arresters.**

Van Horn-Endsley Spark Arrester. Illustrated description of the apparatus, with report of tests. 2500 w. Ry Age Gaz—Dec. 23, 1910. No. 19511.

**Locomotive Superheating.**

Superheaters. R. D. Lewis. Discusses the results of applying superheaters to locomotives, based upon tests made, using the Emerson superheaters. 1200 w. Wis Engr—Dec., 1910. No. 19519 C.

**Locomotive Valve Gears.**

The Lentz Poppet Valve Gear. Illustrates and describes a novel valve gear used by many foreign roads. 1500 w. Am Engr & R R Jour—Dec., 1910. No. 19219 C.

The Intercepting Valve and Its Operation Adapted from Bul. 1006 of the Am. Loc. Co. Illustrations and description showing the entire mechanism and the arrangement of the various steam pipes and passages, giving the intercepting valve in its four different positions. 3000 w. Ry & Engng Rev—Dec. 10, 1910. No. 19284.

**Motor Cars.**

The Suburban Service of the Great Western Railway and the Avoidance of Changing Locomotives from Front to Rear of Trains at the Paris-Nord Station

(Les Services de Banlieue du Great Western Railway et la Suppression des Manœuvres de Passage des Locomotives de Tête en Queue en Gare de Paris-Nord). Emile Bernheim. Describes the system of operation with steam motor cars arranged for distant control. Ills. 2000 w. Rev Gen d Chemins de Fer—Nov., 1910. No. 19614 G.

**Problems.**

Motive Power Problems. F. H. Clark. Address before the College of Engng, Univ. of Ills. A general discussion of problems of design, construction, maintenance, and operation. 3000 w. Ry & Engng Rev—Dec. 3, 1910. No. 19164.

**Shops.**

Care and Selection of Shop Equipment. Gives additional papers submitted by contestants in the recent competition on this subject. 6500 w. Ry Age Gaz—Dec. 2, 1910. No. 19115.

See also Shop Design, and Shop Practice, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

**Snow Plows.**

The Rotary Snow Plow. An illustrated article, reporting replies to questions sent to operating officials, concerning the efficiency of rotary plows. 4500 w. Ry Mas Mech—Dec., 1910. No. 19292.

**Train Lighting.**

The Brown, Boveri & Co. System of Electric Train Lighting (Eclairage électrique des Trains, Système Brown, Boveri et Cie). J. A. Montpellier. Describes the apparatus and electrical connections of the system. Ills. 2400 w. L'Elecn—Nov. 12, 1910. No. 19633 D.

## NEW PROJECTS.

**China.**

Formal Opening of the British Section of the Kowloon-Canton Railway. Illustrated account of the opening of a line connecting Hong-Kong with the Chinese boundary, with information relating to it. 5000 w. Far East Rev—Oct., 1910. No. 19201 N.

The Canton-Hankow Railway. Discusses the question of foreign loans for the construction of this Chinese railway. Ills. 2500 w. Far East Rev—Oct., 1910. No. 19203 N.

**Philippines.**

Opening of the Iloilo-Capiz Line of the Philippine Railway Co. Brief illustrated account. 1000 w. Far East Rev—Oct., 1910. No. 19202 N.

**Western Pacific.**

The Western Pacific Ry. Information concerning this recently opened line extending from Salt Lake City to San Francisco, and of notable construction from both an engineering and an operating point of view. Map. 1000 w. Eng News—Dec. 1, 1910. No. 19053.

**Winston-Salem Southbound.**

North Carolina's Southbound Railway Enterprise. Fred A. Olds. An account of a three-million dollar railway, built in a year, and opened on Nov. 26. Ills. 2000 w. Mfrs' Rec—Dec. 1, 1910. No. 19037.

## PERMANENT-WAY AND BUILDINGS.

**Bridge Testing.**

Impact Tests on Railway Bridges. Report of Committee XV—Iron and Steel Structures. An account of the work, with detailed results of tests, and discussion, etc. Tables and plates. Ills. 2500 w. Am Ry Engng & Main of Way Assn—Bul. 125. July, 1910. No. 19496 N.

**Rail Joints.**

Tests of Rail Joints. McLeod Thompson. Considers track conditions under a moving load, and the points that should govern the test, and points for observation during the test. Ills. 1500 w. Ry Age Gaz—Dec. 2, 1910. No. 19114.

**Roundhouses.**

An Excellent Locomotive Terminal. Illustrated detailed description of the terminal of the N. Y. C. & H. R. R. R. at Corning, N. Y. 5000 w. Am Engr & R R Jour—Dec., 1910. No. 19215 C.

**Snowsheds.**

Concrete and Timber Snowsheds on the Great Northern Ry. Illustrates and describes new protective work on the Cascade Division, which aims to carry across the line the snow that comes from the mountain slopes. 1200 w. Eng News—Dec. 15, 1910. No. 19360.

**Terminals.**

Railroad Construction Work at Louisville. G. D. Crain, Jr. Illustrates and describes extensive improvements in the terminal facilities, including a $2,000,000 bridge, $400,000 viaduct, yardage, etc. 3000 w. Mfrs' Rec—Dec. 15, 1910. No. 19342.

**Tie Plates.**

Tie Plates on American Railways. Gives drawings and statements of fact and opinion quoted from replies received to questions sent to railway engineers, with editorial discussion. 5800 w. Ry Age Gaz—Dec. 9, 1910. No. 19257.

**Tunnels.**

Report No. 5 on the Question of Long Railway Tunnels. Construction, Ventilaiton, and Operation. Rudolf Heine. Explains methods used on Alpine tunnels. Ills. 1700 w. Bul Int Ry Cong—Nov., 1910. No. 19748 G.

The Approaches to the La Salle Street Tunnel at Chicago. Explains difficulties and conditions and outlines the general design of the reconstruction of a double-bore tunnel and approaches. The design of the approaches is illustrated and described. 3000 w. Eng Rec—Dec. 24, 1910. No. 19563.

*We supply copies of these articles. See page 839.*

**Turn Tables.**

Electrically Operated Turn Tables. E. C. Wayne. Gives average operating conditions, showing the cost reduction effected by the use of electricity, and illustrating and describing the construction. 1800 w. Elec Jour—Dec., 1910. No. 19515.

**TRAFFIC.**

**Freight.**

Weak Links in the Chain. Henry Harrison Suplee. Discusses some defective points in transportation systems. 1600 w. Cassier's Mag—Dec., 1910. No. 19543 B.

**Freight Rates.**

Making Rates for a New Railway—An Object Lesson in Economics. Discusses conditions on the newly constructed "Northwest Line," a branch of the "Oregon Short Line," as an example. 2000 w. Ry Age Gaz—Dec. 16, 1910. No. 19378.

**MISCELLANY.**

**Berlin.**

The Traffic Problems of Greater Berlin (Die Verkehrsfragen des Wettbewerbs "Gross Berlin.") Herr Blum. Discusses the projects for the improvement of water and rail transportation (exclusive of rapid transit) submitted in a recent competition. Ills. 6600 w. Glasers Ann—Nov. 15, 1910. No. 19809 D.

**Education.**

See same title, under INDUSTRIAL ECONOMY.

**Germany.**

Five Years' Development of German Railways. Dr. W. Peters. Map, and description of the improvement in organization of the State railways, their extension, and details of rolling-stock improvements are given in the present article. 4500 w. Ry Age Gaz—Dec. 16, 1910. Serial. 1st part. No. 19377.

**Operating Costs.**

The Interstate Commerce Commission's Own Investigation of the Costs of Railway Operation. Gives analysis of cost compiled by the commission. Inset. 1000 w. Ry Age Gaz—Dec. 9, 1910. No. 19256.

# STREET AND ELECTRIC RAILWAYS.

**Brakes.**

Syracuse Instruction Book. Information from this book with reference to the use of air-brakes. Ills. 1200 w. Elec Ry Jour—Dec. 17, 1910. No. 19369.

**Canada.**

Electric Railways in Canada. J. L. Payne. A general review of the financial standing, the equipment, and operation. 1800 w. Elec Ry Jour—Jan. 7, 1911. No. 19985.

**Car Heating.**

Recent Developments in Car Heating and Ventilation. H. S. Williams. Abstract of paper read before the Cent. Elec. Ry. Assn. Discusses the requirements and methods of obtaining the best results. 1800 w. Elec Ry Jour—Dec. 3, 1910. No. 19147.

**Car Houses.**

See Reinforced Concrete, under CIVIL ENGINEERING, CONSTRUCTION.

**Car Lighting.**

Tantalum Lamps on Chicago Railway Cars. Reports tests made which have resulted in their installation. 1800 w. Elec Ry Jour—Dec. 17, 1910. No. 19370.

**Cars.**

Center-Vestibule Steel Cars for the Oklahoma Railway Company. Illustrated description of steel cars of the prepayment center entrance and exit type. 800 w. Elec Ry Jour—Dec. 10, 1910. No. 19250.

**Car Ventilating.**

See Car Heating, under STREET AND ELECTRIC RAILWAYS.

**Car Wheels.**

Improvements in Street Car Wheels. S. M. Coffin. Abstract of paper read before the Ala. Light & Trac. Assn. Notes on the recent improvements and experience with steel wheels. 1200 w. Elec Ry Jour—Dec. 24, 1910. No. 19502.

**Controllers.**

Controllers for Electric Railways (Le Controle des Equipments de Traction électrique). H. Marchand. A study of methods and apparatus of control in the various systems of electric traction. Ills. Serial. 1st part. 2500 w. Tech Mod—Nov., 1910. No. 19619 D.

**Costs.**

See Electrification, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

**Franchises.**

Elements of a Constructive Franchise Policy. Delos F. Wilcox. Part of a paper read before the Nat. Munic. League discussing street railway franchises. 3000 w. Eng News—Dec. 8, 1910. No. 19232.

**Germany.**

The Electric Railways of Germany During the Year 1910. A general review of the service and matters related. 2000 w. Elec Ry Jour—Jan. 7, 1911. No. 19984.

**Great Britain.**

Electric Traction in Great Britain. A general review of existing lines, the problems, etc. 4000 w. Elec Ry Jour—Jan. 7, 1911. No. 19983.

**Interurban.**

Interurban Construction in the Central States During 1910. Gives a map of the Central States showing the location of interurban lines and review of progress in mileage. 1800 w. Elec Ry Jour—Jan. 7, 1911. No. 19982.

*We supply copies of these articles. See page 839.*

**Locomotives.**

The T. C. R. T. Locomotive. C. M. Jesperson. Describes a locomotive built for switching purposes, noticeable for its simplicity and its reversibility. 800 w. Minn Engr—Nov., 1910. No. 19761 C.

Recent Swiss Trunk-Line Electrical Locomotives (Beschreibung der hauptsächlichsten neueren schweizerischen Lokomotiven für elektrischen Vollbahn-Betrieb). Briefly describes important machines. Ills. 3500 w. Schweiz Bau—Nov. 5, 1910. No. 19692 B.

**Long Island.**

The New York & North Shore Traction Company. L. P. Crecelius and R. W. Emerson. Illustrated description of an electric railway system connecting the various towns and villages within the Long Island suburban district. 3500 w. Elec Ry Jour—Dec. 24, 1910. No. 19501.

**Management.**

Development of the Office of Superintendent of the Day, Boston Elevated Railway Company. Edward Dana. Gives details and methods of this office, developed in connection with special study of traffic conditions. 800 w. Elec Ry Jour—Dec. 3, 1910. No. 19144.

**Monorail.**

Monorail Gyroscope Railways (Zur Frage der Einschienenkreiselbahnen). Kurt Wiesinger. Briefly describes the systems and examines their possibilities. Ills. 4200 w. Elek Kraft u Bahnen—Nov. 14, 1910. No. 19821 D.

**Motor Gears.**

Wear of Railway Motor Gear and Pinion Teeth—Causes and Suggested Means of Relief. T. W. Williams. Abstract of paper read before the Cent. Elec. Ry. Assn. 1500 w. Elec Ry Jour—Dec. 3, 1910. No. 19146.

**Municipal Control.**

The Electric Railway Situation. Thomas N. M'Carter. Abstract of address before the New England Street Ry. Club. Discusses the public demands for regulating corporations. 3000 w. Elec Ry Jour—Dec. 31, 1910. No. 19782.

**New York.**

A Great Rapid Transit System for a Great City. Map and illustrations, with explanation of the proposed plan for doubling the capacity of New York City subways and elevated roads. 1700 w. Sci Am—Dec. 17, 1910. No. 19365.

Concerning "Good" Corporations and "Bad" Corporations, and How to Reform the Latter. Editorial discussion of the extension of the subways of N. Y. City and the two propositions under consideration. 2500 w. Eng News—Dec. 15, 1910. No. 19362.

**Paris.**

Public Transport Systems in Paris. Map and information concerning the new municipal system of tramways and the revision of the omnibus system. 2500 w. Tram & Ry Wld—Dec. 8, 1910. No. 19500 B.

**Power Plants.**

See Central Stations, and Hydro-Electric, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

**Railless.**

Railless Electric Traction Systems (Elektrische Automobilstrecken mit Oberleitung). H. Maurer. Briefly describes the Daimler system. Ills. 2500 w. Schweiz Bau—Nov. 12, 1910. No. 19693 B.

**Shops.**

New Shops of Utah Light & Railway Company. An illustrated account of the shops under construction and other improvements. 1000 w. Elec Ry Jour—Dec. 10, 1910. No. 19249.

**Signaling.**

Automatic Block Signals and Train Stops on Single Track Interurban Line of the Washington Water Power Company. Illustrated description of the installation of a complete alternating-current signal system. 3500 w. Elec Ry Jour—Dec. 17, 1910. No. 19368.

**Subways.**

See same title, under CIVIL ENGINEERING, CONSTRUCTION; and New York, under STREET AND ELECTRIC RAILWAYS.

**Three-Phase.**

Three-Phase Trunk Lines in Europe (Drehstromvollbahnen in Europa). R. E. Hellmund. A general discussion of three-phase traction practice. Ills. 3400 w. Elektrotech u Maschinenbau—Nov. 13, 1910. No. 19827 D.

**Track Reconstruction.**

Double Tracking and Grade Revision on an Interurban Electric Railway. Luther Dean. Illustrates and describes the revision of a part of the line between a city and a pleasure park, to facilitate the safe handling of heavy traffic. 2000 w. Eng News—Dec. 15, 1910. No. 19356.

**Track Standards.**

Track Department Standards of New York State Railways. Gives standard designs of track and right-of-way structures recently adopted by Rochester interurban lines. Ills. 1000 w. Elec Ry Jour—Dec. 3, 1910. No. 19145.

**Train Operation.**

Operating a Long Island Railroad Motor Train. W. B. Kouwenhoven. Directions and suggestions for operating and for meeting emergencies. Ills. 2500 w. Ry & Loc Engng—Dec., 1910. No. 19150 C.

**Valuation.**

The Basis of Valuation in Case of Municipal Purchase of Street Railways. Sidney Ossoski. Discusses methods of valuation used at Chicago and Cleveland, as examples. 2500 w. Elec Ry Jour—Nov. 12, 1910. No. 18465.

*We supply copies of these articles. See page 839.*

## EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first instalment.

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## THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *w.* London.
Electrical Engineering. *w.* London.
Elec. Review and W. Elec'n. *w.* Chicago.
Electrical Review. *w.* London.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Far Eastern Review. *m.* Manila.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Am. Soc. of Engineering-Contractors. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *w.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.